ROUX

Remedial Investigation Work Plan

Diagravure Film Manufacturing Site
NYSDEC Project Number C224403
268 Bergen Street,
287 Wyckoff Street, and
N/A Wyckoff Street
Brooklyn, New York

June 24, 2024

Prepared for:

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Certification

I, Robert Kovacs, certify that I am currently a Qualified Environmental Professional (QEP) as defined in 6 NYCRR Part 375 and that this Remedial Investigation Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation's (DER's) Technical Guidance for Site Investigation and Remediation (DER-10), dated May 2010 and DER Green Remediation (DER-31).

Robert Kovacs, P.G. #000437	June 24, 2024	
Qualified Environmental Professional	Date	Signature

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux) on behalf of Bergen St Equity LLC (Bergen St, or Applicant), has prepared this Remedial Investigation Work Plan (RIWP) for the Diagravure Film Manufacturing Site, located at 268 Bergen Street, 287 Wyckoff Street and N/A Wyckoff Street, Brooklyn, New York (Site). A Site Location Map is provided as Figure 1. The Site is identified as New York City Tax Block 388, Lots 19, 42, and 51, County of Kings, City of New York. The Site is planned to be investigated and properly remediated under the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP).

The planned redevelopment of the Site is not yet designed; however, the proposed development will likely consist of a mixed-use residential building with commercial use on the ground floor. The mixed-use building being contemplated is nine stories tall with 335 units. Approximately 25% of the units will be affordable housing.

1.1 Brownfield Cleanup Program Application and Environmental Work Plans

Due to the presence of confirmed contaminated soil, groundwater, and soil vapor at the Site, the Applicant plans to remediate the Site under the NYSDEC BCP. An application for the BCP was submitted concurrently with this RIWP, and a BCP Site number will be assigned to the Site upon acceptance of the Brownfield Cleanup Agreement (BCA). Bergen St Equity LLC is the prospective Volunteer under the NYSDEC BCP. This RIWP was developed in accordance with the DER 10 Technical Guidance for Site Investigation and Remediation, dated May 2010 (DER 10).

The purpose of the Remedial Investigation (RI) is to determine the nature and extent of contamination at the Site, characterize environmental media, qualitatively assess the potential exposure of receptors to Site contaminants, and develop any other additional data necessary to support the development of a Remedial Action Work Plan (RAWP).

1.2 RIWP Document Organization

This RIWP contains a background section (Section 2) describing the Site, its history, and results of previous environmental investigations; a section defining the objectives and scope of the RI (Section 3); and Sections 4 and 5 that describe project operations plans (e.g., Quality Assurance/Quality Control, Health and Safety). Reporting requirements and the project schedule are discussed in Section 6. Figures are provided to illustrate site conditions and the locations of proposed sampling efforts.

1.3 Project Team and Contact Information

Roux's Principal-In-Charge for this Site will be Robert Kovacs, P.G., Principal Scientist, who will be responsible for the overall implementation of the project. Roux's Engineer of Record will be Omar Ramotar, P.E. Roux's Project Manager will be Julia Michaels, Project Scientist, who will be responsible for day-to-day management of the project, including preparation of work plans, scoping, and directing field activities. Rachel Henke will serve as the Quality Assurance Officer for this project. The Field Manager for the RI, who will be determined prior to the start of work, will be responsible for implementing and directing field activities onsite. The project team is primarily based in Roux's Islandia, New York, headquarters office and can be reached at (631) 232-2600.

The name and contact information for the Applicant is:

Mr. Mordy Fulop
Bergen St Equity LLC

Laboratory analysis will be completed by TestAmerica Laboratories, Inc. (Eurofins) of Edison, New Jersey, a NYSDOH Environmental Laboratory Accreditation Program (ELAP)-certified laboratory. Waste disposal, drilling, and other subcontracted services have not been selected as of preparation of this RIWP. This information will be provided to the NYSDEC prior to the start of field activities.

2. Background

This section provides pertinent background information, including a description of the Site and its setting, the history of the Site, and the results of previous environmental work conducted at the Site.

2.1 Site Description and Setting

A Site location map is included as Figure 1. A land use map is included as Figure 2.

Property Location	
Property Name:	Diagravure Film Manufacturing Site
Property Address:	268 Bergen Street, 287 Wyckoff Street and N/A Wyckoff Street, Brooklyn, New York
Property Town, County, State:	Kings County, New York
Property Tax Identification:	Block 388 Lot 19, 51, and 42
Property Topographic Quadrangle:	USGS; 2019, Brooklyn, NY 7.5 Minute Topographic Quadrangle
Nearest Intersection:	3rd Avenue and Wyckoff Avenue
Area Description:	Lot 19 of the Site consists of a two-story manufacturing and warehouse building that houses the Ulano Corp. screen-printing and manufacturing operation. The eastern portion of the first floor of Lot 19 consists of machinery used in the screen-printing and chemical manufacturing processes, including chemical mixers, screen printers, screen cutters, and water distillers. Lot 42 of the Site consists of the administrative portion of the Ulano Corp. facility. The lot is developed with a one-story building connected to the screen-printing facility, and consists of typical administrative offices, storage rooms, utility rooms, and a lounge. Lot 51 of the Site consists of a vacant lot that is blocked off by a chain link fence.

Property Information	
Property Acreage:	1.19 acres
Property Shape:	Polygon
Property Use:	Industrial & Manufacturing
Improvements:	The Site currently consists of a two-story manufacturing building on Lot 19, an attached one-story office building on Lot 42, and a vacant lot on Lot 51.

The previous reports generated for the Site are included in Appendix A, and can be found at Index of /data/DecDocs/C224403 (ny.gov)

2.1.1 Property Operations

Lot 19 of the Site consists of a two-story manufacturing and warehouse building that formerly housed the Ulano Corp. screen-printing and manufacturing operation, which vacated the property in March 2023. The eastern portion of the first floor of Lot 19 consists of machinery used in the screen-printing and chemical manufacturing processes, including chemical mixers, screen printers, screen cutters, and water distillers. The western portion of the first floor of Lot 19 consists of a warehouse and storage area for finished products and bulk materials related to product shipping, including cardboard and plastics. A loading dock with two garage doors is located in the northwestern corner of Lot 19. A partial basement with a water heater and two sumps is located in the northeastern corner of Lot 19. The second floor of Lot 19 consists of a quality assurance laboratory, research and development laboratory, several offices, and storage rooms. A portion of Lot 19 that adjoins Wyckoff Street is used as a private parking lot. The parking lot for the screen-printing facility is located on the eastern adjoining property to the south of the filling station on 3rd Avenue.

Lot 42 of the Site consists of the administrative portion of the Ulano Corp. facility. The lot is developed with a one-story building connected to the screen-printing facility, and consists of typical administrative offices, storage rooms, utility rooms, and a lounge.

Lot 51 of the Site consists of a vacant lot that is blocked off by a chain link fence.

2.1.2 Utilities

The Site was observed to be connected to municipal water, sewer, electric, and natural gas utilities.

2.1.3 Topography

The average elevation of the Site is approximately 23 feet above mean sea level (ft amsl) as shown in the USGS 7.5 Minute Series Topographic Map (Appendix F).

2.1.4 Wetland Areas and Surface Water Bodies

According to the National Wetlands Inventory, the Site is not located in or adjoining to a wetland. According to FEMA Flood Maps, the Site is not located within the 100-year or 500-year flood zones.

2.1.5 Soil

Based on the findings of the Phase II Environmental Site Investigation (ESI) performed by VHB, documented in a Phase II ESI Report dated March 27, 2023 (the VHB Phase II ESI), the Site is underlain with a mixture of fill consisting of asphalt, brick and concrete to a maximum depth of 15 feet below land surface (ft bls). Beneath the fill, the subsurface is predominantly comprised of sand and silt.

2.1.6 Groundwater

Based on the findings of the VHB Phase II ESI, groundwater was encountered approximately 18 – 20 ft bls. Groundwater flow direction was not evaluated as part of the VHB Phase II. The regional direction of groundwater flow in the vicinity of the Site is assumed to flow towards the southwest in the direction of the Gowanus Canal. Groundwater flow direction will be confirmed during the RI.

2.1.7 Neighboring Properties and Zoning

The Site is located in the county of Kings, city and state of New York. The areas surrounding the Site are developed commercial and residential propertied. The Site is bounded to the north by commercial use buildings, to the south by residential use and commercial use warehouse, to the east by a gasoline fill station, parking lot, and medical office, and to the west by residential use buildings. The Site is currently zoned as industrial and manufacturing.

2.2 Site History

Roux reviewed the following information sources to determine the historic uses of the Site, which were contained in the Roux September 2023 Phase I Environmental Site Assessment (ESA), included in Appendix A of this RIWP:

- Historical aerial photographs dated between 1924 to 2019
- Historical certified sanborn fire insurance maps dated between 1886 to 2007
- Review of federal, state, and local environmental regulatory agency databases provided by Environmental Data Resources (EDR), Inc. of Milford, Connecticut indicating locations of environmental concern within specified radii from the Site.

According to the sources above, the Site earliest site improvements noted in 1938 was a milk depot, private auto parking facility, sign manufacturing facility, as well as stores and dwellings. By 1950, the northern portion of Lot 19 was developed as a garage and office, while the southern portion of the lot contained residences. By 1969, and through 2007, the Site was identified as Diagravure Film Corp., a film manufacturer. Sometime after 2007, Ulano Corp. replaced the former film manufacturer.

2.3 Environmental Conditions/Results of Previous Environmental Investigations

This section provides an overview of previous environmental-related activities completed at the Site (in addition to the Phase I ESA completed by Roux), based on a review of readily available information and the following environmental reports (provided in Appendix A). The following environmental reports were available for review:

- Matrix New World (Matrix), Phase I ESA, 280 Bergen Street, 265 Wyckoff Street, and 287 Wyckoff Street, Brooklyn, Kings County, New York, dated August 2018;
- VHB, Limited Phase II ESI, 280 Bergen Street, Brooklyn, New York, dated March 27, 2023;
- VHB, Sub-Slab Soil Vapor Investigation, 287 Wyckoff Street, Brooklyn, New York, dated March 27, 2023; and
- Roux, BCP Eligibility Investigation, 280 Bergen Street, Brooklyn, New York, performed September 26, 2023.

A summary of the findings from assessments of the Site is provided below. The reports are provided in Appendix A.

<u>Phase I ESA, prepared by Matrix, dated August 2018</u>

Several recognized environmental conditions (RECs) were identified in the Matrix Phase I ESA. The RECs are summarized as follows:

- <u>Chemical Storage:</u> Matrix observed drums, buckets, and totes containing various chemicals used in the screen-printing manufacturing process throughout the screen-printing facility on Lot 19. The containers were stored on pallets, shelves, or directly on the ground. Staining was observed on the concrete floor next to containers and equipment. Cracks were also observed on the concrete floor where staining was identified.
- <u>Adjacent Filling Station:</u> Matrix indicated that a filling station is present on the eastern adjoining property of 98 3rd Avenue and has been in operation since at least 1969. An open NYSDEC spill case (1406201) was associated with the filling station. A Phase II ESA was performed by Impact

Environmental at the filling station in April 2014. The results indicated that soil, groundwater, and soil vapor contamination was present at the property. Groundwater at the filling station was determined to flow towards the north-northwest, in the direction of Lot 19. Impact Environmental indicated in a letter to the NYSDEC dated March 2018 that groundwater contamination extends past the boundaries of the filling station. Remediation was proposed for the filling station under the New York City Voluntary Cleanup Program (NYC VCP) to resolve the NYSDEC spill case. As of the date of the Roux Phase I ESA, the spill case is still open.

- <u>Fill Material and Former Structures:</u> Matrix identified multiple historical buildings, including dwellings, stores, and factories that were demolished between 1951 and 1969. There is a possibility that demolition debris was disposed on-site. The potential for contamination associated with buried former building materials (including asbestos and lead-based paint) was considered a REC by Matrix. Matrix also cited former building materials buried at the adjacent filling station as an environmental concern, as the Phase I ESA and Phase II ESA performed by Impact indicated that contaminants attributed to historic fill were found to be exceeding New York City Rules and Regulations (NYCRR) Part 375 standards for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals.
- <u>Upgradient Dry Cleaner:</u> Matrix identified a former dry cleaner (Fashion Cleaners) that was operational from 1997 to 2002 on Lot 41, which adjoins the Site office building to the east. The facility is currently listed in the EPA Envirofacts database as a former small quantity generator of halogenated solvents, including tetrachloroethylene (PCE) and trichloroethylene (TCE).
- <u>Former Gasoline Tank:</u> Matrix indicated that a 10,000-gallon fuel oil tank was removed from the northeastern portion of the Site in 2018. A gasoline tank was identified in the same area in Sanborn maps dated between 1969 and 2007. Matrix also indicated that eight underground storage tanks (USTs) containing gasoline were removed from the Site in 1993. Matrix could not confirm if the gasoline tank identified in the Sanborn map was one of the tanks that were confirmed to have been removed from the Site in 1993 or 2018.
- <u>Vapor Encroachment Condition (VEC):</u> Matrix identified a VEC based on the various industrial facilities upgradient to the Site, including the eastern-adjoining filling station that is known to have soil, soil vapor, and groundwater contamination.

Matrix identified the closed USTs and a closed NYSDEC spill case associated with them (9713764) as an HREC. No CRECs were identified at the Site. Matrix noted one drywell on Lot 51 that discharges directly to the subsurface, which Matrix indicated is an environmental concern that is not considered a REC.

<u>Limited Phase II Environmental Site Investigation (ESI) prepared by VHB, dated March 27, 2023</u>

VHB performed a Limited Phase II ESI in March 2023 to further investigate the findings of the Matrix Phase I ESA. The VHB Limited Phase II investigated soil, groundwater, and soil vapor in Lots 19 and 51 at the Site. The investigation included the collection of sixteen soil samples, four groundwater samples, and six soil vapor samples. The results of the Limited Phase II are summarized below:

Soil

Sixteen soil samples were collected from shallow and deep intervals (0-2 ft bls and 10-12 ft bls, respectively) and analyzed for VOCs, SVOCs, PCBs, and metals. Soil samples were compared to NYCRR Part 375 Unrestricted Use (UU), Residential Use (RU), and Restricted-Residential (RR) Use Soil Cleanup Objectives (SCOs).

VOC exceedances of UUSCOs were found in two deep soil sample locations. No VOCs were detected above RUSCOs or RRSCOs. Multiple SVOCs were detected above RUSCOs or RRSCOs in six shallow soil samples and one deep soil sample location. PCBs were detected above UUSCOs in two shallow and one deep soil samples. Metals were detected above RRSCOs in five shallow soil samples and one deep soil sample.

A summary of UUSCO, RUSCO, and RRSCO exceedances in soil are depicted on Figure 4 and in Table 1 through Table 5.

Groundwater

Four groundwater samples were collected from four temporary monitoring well locations and analyzed for VOCs, SVOCs, and Metals. Groundwater sample results were compared to 6 NYCRR Part 703 Groundwater Quality Standards (AWQSGVs) and NYSDEC TOGS 1.1.1 Guidance Values. Two of the four groundwater samples collected showed VOCs at concentrations exceeding AWQSGVs. SVOCs and Metals were detected in all four samples at concentrations exceeding AWQSGVs.

A summary of AWQSGV exceedances in groundwater are depicted on Figure 5 and in Tables 6 through 10.

Soil Vapor

Six soil vapor samples were collected from temporary soil vapor sampling points and analyzed for VOCs. Soil vapor sample results were compared to the NYSDOH Soil Vapor/Indoor Air Matrix A, B, or C. VOCs in exceedance of Matrix A, B, or C guidance values were detected in three soil vapor samples.

Detections of VOCs in soil vapor are depicted on Figure 6 and in Table 11.

<u>Sub-Slab Soil Vapor Investigation prepared by VHB, dated March 27, 2023</u>

VHB performed a sub-slab soil vapor investigation in Lot 42, only, at the Site. As part of the investigation, two sub-slab soil vapor points were installed, and one sample was collected from each point. The results were compared to the NYSDOH Soil Vapor/Indoor Air Matrix A, B, or C. VOCs in exceedance of NYSDOH Soil Vapor/Indoor Air Matrix B mitigation level were detected in both samples.

Detections of VOCs in soil vapor are depicted on Figure 6 and in Table 11.

<u>BCP Eligibility Investigation prepared by Roux, performed September 26, 2023.</u>

Roux performed a BCP Eligibility Investigation (BCPEI) in Lot 42, only, at the Site. As part of this investigation, three soil borings were advanced to approximately 4’ bls. Two samples were collected from each soil borings at two intervals; 0-2 ft bls and 2-4’ bls. Only one sample interval, 0-2’ bls, was collected from RXSB-2 due to refusal encountered at 24”. All soil samples were analyzed for SVOCs, and metals. The results were compared to UUSCOs and RRSCOs.

Exceedances of UUSCO, RSCOs, and RRSCOs in soil are depicted on Figure 4 and in Tables 2 and 3.

2.3.1 Identification of Areas of Concern (AOCs) Based on Previous Investigations

Based on the findings of the prior investigations, the following AOCs that will be further investigated as part of this RIWP include:

- Historic fill based on previously identified fill material at depth at the Site;
- Presence of potential impacts to soil and groundwater from former 10,000 gallon UST;
- Presence of potentially impacted soil and groundwater from the adjacent gasoline fill station; and
- Presence of potential impacts from historic on-Site operations.

3. RI Work Plan Objectives, Scope, and Rationale

Roux, on behalf of the Applicant, has developed a RI scope of work (presented in this RIWP) that is intended to satisfy NYSDEC BCP requirements. Data collected during the RI will determine the basis for remedial actions for the Site.

Standards, Criteria, and Guidance (SCGs) for soil at BCP sites are the numerical soil cleanup objectives (SCOs) presented in 6 NYCRR Part 375 (Part 375). The SCOs are categorized into unrestricted use criteria and restricted use (residential, restricted-residential, commercial, or industrial) criteria, as well as criteria for protection of groundwater (PGW) and ecological resources. The applicability of each category of SCOs is determined based upon the current and reasonably anticipated future use of the Site, as well as cleanup tracks being evaluated. The anticipated redevelopment will likely include a mixed-use residential building; the applicable standards for contemplation of a Track 2 or Track 4 restricted use remedy are the RRSCOs and AWQSGVs for those contaminants detected in groundwater. If a Track 1 remedy is contemplated the applicable standards are the UUSCOs.

New York State Department of Health's (NYSDOH's) Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006 (NYSDOH Guidance), Revised February 2024, employs six Matrices to determine whether monitoring or mitigation of soil vapor levels are warranted, based on concentrations present in sub-slab and indoor air samples. Potential soil vapor impacts identified in accordance with the NYSDOH Guidance will be considered.

Roux, on behalf of the Applicant, has developed a RI scope of work (presented in this RIWP) that is intended to satisfy NYSDEC BCP requirements. Data collected during the RI will determine the basis for remedial actions for the Site.

3.1 Objectives

Based on the existing data for the Site, the following objectives have been identified for the RI portion of this RIWP:

- Further delineate the nature and extent of potential impacts to soil;
- Further delineate the nature and extent of potential impacts to groundwater within the Site and the potential for migration onto or off the Site;
- Further evaluate the nature and extent of soil vapor quality within the Site and the potential for migration onto or off the Site; and
- Collect sufficient data to perform a qualitative human health exposure assessment (QHHEA) for on-Site and off-Site receptors.

The RI will evaluate soil, groundwater, and soil vapor impacts on-Site and at the Site property boundaries to provide the basis for remedial action selection and to determine the general potential for off-Site impacts. Environmental data collected during the RI will be used to develop the information necessary to support the development of a RAWP.

3.2 RI Scope

The scope of the RI will include the collection of sufficient Site investigation data so that, together with the historical data, the entire Site will be sufficiently characterized to support the development of the Site-wide RAWP.

To accomplish this, the scope of work for the RI will include the following:

- The performance of Site reconnaissance and a geophysical investigation to confirm proposed sampling locations;
- The advancement of soil borings, collection of soil samples, installation of permanent groundwater monitoring wells, collection of groundwater samples from new monitoring wells, installation of soil vapor points, and sampling of new soil vapor points;
- The collection of soil, groundwater, and soil vapor sufficient to define the nature and extent of impacted media and current Site conditions and offsite groundwater and/or soil vapor migration potential;
- The collection of a synoptic round of groundwater level measurements and the collection of additional land survey data as needed for developing a groundwater elevation contour map; and
- The performance of a qualitative human health exposure assessment (QHHEA) to identify existing and potential exposure pathways and evaluate contaminant fate and transport.

All investigation activity will be conducted in accordance with the applicable requirements of the NYSDEC DER-10.

Soil and groundwater samples collected from the soil investigation described in Tables 12a and 12b for soil and groundwater, respectively, will be analyzed for the full Part 375/Target Compound List (TCL) plus 30 highest concentration tentatively identified compounds (TICs) (10 VOCs and 20 SVOCs), TAL metals, TCL pesticides, TCL PCBs, and emerging contaminants (ECs) 1,4-Dioxane and Per – and Polyfluoroalkyl Substances (PFAS), which include the 40 compounds listed in the NYSDEC April 2023 Groundwater Sampling for Emerging Contaminants Guidance (NYSDEC April 2023 Guidance). The 40 compounds listed in the NYSDEC April 2023 Guidance is included in Table 7 of the QAPP. Soil samples will also be collected for geologic logging in accordance with the Unified Soils Classification System (USCS) and for visual inspection (for evidence of contamination including staining and/or odors).

To delineate and characterize groundwater quality beneath the Site, groundwater samples from the groundwater investigation described in detail below will also be analyzed for the full Part 375/TCL+30 TICs, TAL metals, TCL pesticides, TCL herbicides, TCL PCBs, and ECs.

All soil vapor air samples will be analyzed for VOCs using United States Environmental Protection Agency (USEPA) Method TO-15, as described in Table 12c.

During the RI, Roux will conduct air monitoring in accordance with a Site-specific Community Air Monitoring Plan (CAMP), which has been prepared for the Site and is provided as Appendix B. CAMP will be implemented during all ground-intrusive activities. Outdoor ground-intrusive activities will require an upwind and downwind monitoring station, while indoor ground-intrusive activities will require only monitoring in the breathing zone of onsite workers.

Quality Assurance/Quality Control (QA/QC) protocols will be followed to ensure that suitable and verifiable data results from sampling and analysis are obtained. To accomplish this, a Quality Assurance Project Plan/ Field Sampling Plan (QAPP/FSP) has been prepared and is provided as Appendix C.

All data will be produced in accordance with NYSDEC Analytical Services Protocol (ASP) Category B deliverables and will be reviewed and validated by Judy V. Harry of Data Validation Services, Inc. (DVS), an independent data validator. Data Validation Services will prepare a Data Usability Summary Report (DUSR) before data is incorporated into the RI Report (RIR) for the Site. All data will be submitted to NYSDEC in electronic format, in accordance with DER-10, Section 1.15.

The overall scope of each component of the RI is discussed in the following subsections. Detailed field sampling procedures are provided in the QAPP/FSP. The proposed sampling locations are shown on Figure 7 of this RIWP and additional information, including intervals to be sampled and sample rationale, is provided in Tables 12a, 12b, and 12c of this RIWP.

3.2.1 Site Reconnaissance and Geophysical Survey

Roux has performed Site reconnaissance and has identified potential AOCs, described in Section 3.1., which will be targeted during the RI. An inspection of the existing Site conditions will be conducted to determine final locations of soil borings and monitoring wells based on actual field conditions.

A geophysical investigation using ground penetrating radar (GPR) will be performed to identify any potential underground storage tanks (USTs), or subsurface interconnected piping associated with former operation. If the geophysical survey indicates the presence of any subsurface structures, the location will be depicted on a plan view map of the Site and will be included as part of the RIR. Soil boring, monitoring well, and/or soil vapor point locations can be adjusted in the field based off the results of the geophysical investigation.

3.2.2 Soil Investigation

To further characterize soil conditions at the Site and fill existing data gaps, twelve borings (RXSB-4 through 15) will be installed at the locations shown in Figure 7 and indicated below. Boreholes will be pre-cleared to five ft bls using non-intrusive methods, such as hand tools and/or vacuum excavation, prior to advancement of soil borings to verify the absence of utilities and/or other subsurface features (i.e., obstructions and/or utilities). Should a utility or other feature be observed during pre-clearance activities, the sampling location will be relocated to no more than ten feet away from the original proposed sample location. If a boring is proposed to be moved more than ten feet from the location shown on Figure 7, the NYSDEC project manager will be consulted prior to installing the boring at the new location. Soil samples will be collected by utilizing the Geoprobe® direct-push rig. Soil samples will be collected continuously from land surface to the groundwater interface, which is estimated to be encountered approximately 18 to 20 ft bls. During installation of the soil borings, the lithology will be recorded, and soil will be inspected for evidence (visual or olfactory) of contamination and field screened continuously for VOCs using a PID with a 10.6 eV lamp.

Visibly contaminated soil cuttings will be placed into sealed and labeled Department of Transportation (DOT) approved 55-gallon drums, pending characterization and offsite disposal at a permitted facility.

3.2.3 Groundwater Investigation

To further evaluate groundwater quality conditions, Roux will collect up to nine groundwater samples from Nine new permanent groundwater monitoring wells (RXMW-4 through RXMW-12).

The proposed groundwater monitoring well locations are shown on Figure 7. The locations of monitoring wells were chosen to extend the general Site coverage based on the locations of previous groundwater sample locations. All monitoring wells will be surveyed for horizonal coordinates, land surface elevation, and measuring point elevation.

Boreholes will be pre-cleared to five ft bls using non-intrusive methods such as hand tools and/or vacuum excavation prior to advancement of soil borings, to verify the absence of utilities and/or other subsurface features (i.e., obstructions and/or utilities). Should a utility or other feature be observed during pre-clearance activities, the well location will be relocated to no more than ten feet away from the original proposed sample location. If a well is proposed to be moved more than ten feet from the location shown on Figure 7, the NYSDEC project manager will be consulted prior to installing the boring at the new location. Permanent monitoring wells will be constructed to bridge the water table. The wells will be installed to a maximum anticipated depth of 25-27 ft bls with approximately three feet of screen above the water table and seven feet of screen below the water table which is expected to range from 18-20 ft bls. Additional monitoring well design details are provided in the QAPP/FSP.

Following installation of the permanent wells, the depth to groundwater in all on-Site monitoring well will be measured using an electronic water level meter and a groundwater contour map will be developed using the survey data. All onsite wells will then be sampled consistent with USEPA low-flow sampling requirements using a bladder pump and one round of groundwater samples will be collected in accordance with the QAPP/FSP and analyzed for:

- TCL + 30/TAL/Part 375 (including filtered and unfiltered metals [including hexavalent chromium], SVOCs, PCBs and pesticides) and ECs.

Field parameters (e.g., pH, dissolved oxygen, oxidation-reduction potential [ORP], etc.) will also be collected using a water quality meter during purging and prior to sampling.

3.2.4 Soil Vapor Investigation

To further evaluate soil vapor and the potential for soil vapor intrusion in the proposed building, six permanent soil vapor points will be installed (RXSV-4 through RXSV-9) during the RI to evaluate soil vapor conditions within and outside of the proposed building foundation footprint.

The soil vapor samples will be collected from soil vapor points installed using a Geoprobe® direct-push rig to the target depth of 5 feet bls. New Teflon®-lined tubing will be attached to an expendable soil vapor sampling point with a 6-inch stainless steel screen. The soil vapor points will be backfilled with #2 Morie sand to approximately one foot above the screen. The remainder of the borehole will be backfilled with a concrete/bentonite slurry to grade.

In accordance with the NYSDOH Guidance for Evaluating Soil Vapor Intrusion, the integrity of each soil vapor sampling point seal will be checked following installation to verify that the soil vapor sample will not be compromised by inadvertent introduction of ambient air into the sample. The soil vapor samples will be collected using pre-cleaned (batch certified) 6-liter summa canisters with regulators calibrated to collect samples over a 2-hour period and analyzed using USEPA Method TO-15 for VOCs. The proposed soil vapor sampling locations are shown on Figure 7. Additional details regarding soil vapor sampling methods are provided in the QAPP/FSP (Appendix C).

3.2.5 Investigation Laboratory Analysis

All soil, groundwater, and soil vapor samples will be analyzed at a NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratory. Additional details regarding laboratory analysis are included in the QAPP/FSP (Appendix F).

All analytical data for the RI will be analyzed on a standard 5-day turn-around-time (TAT). All data will be produced in accordance with NYSDEC Analytical Services Protocol (ASP) Category B deliverables and will be reviewed and validated by a third-party data validator, who will prepare a DUSR before being incorporated into the RIR for the Site. All data will be submitted to the NYSDEC in electronic format, in accordance with DER-10.

4. Quality Assurance/ Quality Control (QA/QC)

The goal of the QA/QC aspect of the RI is to ensure that suitable and verifiable data results from sampling and analyses are performed. To accomplish this, a QAPP/FSP has been prepared and is provided as Appendix C.

5. Health and Safety

A Site specific Health and Safety Plan (HASP) has been prepared for the Site and is provided in Appendix D. A site-specific Community Air Monitoring Plan (CAMP) has been prepared for the Site and is provided as Appendix B.

6. Reporting and Schedule

The following will be provided to the NYSDEC during the course of the RI work.

Daily Progress Reports

Daily progress report submittals to be provided to the NYSDEC and NYSDOH Project Managers during RI field activities and will include the following.

- An update of progress made during the reporting day;
- Locations of work;
- References to alpha-numeric map for Site activities;
- A summary of any and all complaints with relevant details (names, phone numbers);
- A summary of CAMP findings, including exceedances;
- An explanation of notable Site conditions;
- One-week look ahead;
- Discovery of any previously unknown contaminated media during RI activities will be promptly communicated to NYSDEC's project manager; and
- A Site map will be provided to identify locations discussed in progress reports provided to NYSDEC.

Remedial Investigation Report and Remedial Action Work Plan

Following the completion of the RI, a RIR will be prepared to summarize the results and findings of the RI. The RIR will be submitted under separate cover from the RAWP.

The RIR and RAWP will include all data developed during the RI and will meet the technical requirements of DER-10.

Scope of Work	Approximate Start Date
Submit Remedial Investigation Work Plan (RIWP)	October 2023
Receive DEC initial review comments and resubmit RIWP	November 2023
Finalize RIWP with any NYSDEC/ NYSDOH Comments, NYSDEC Approves RIWP	June 2024
Remedial Investigation (1-2 weeks of field work)	July 2024
Draft and submit Remedial Investigation Report (RIR)	August – September 2024
Draft and submit Remedial Action Work Plan (RAWP)	September – October 2024

Respectfully submitted,

ROUX ENVIRONMENTAL ENGINEERING AND GEOLOGY, D.P.C.

Julia Michaels

Julia Michaels
Project Scientist

Robert Kovacs, P.G.
Principal Scientist

TABLES

Notes Utilized Throughout Tables

Soil Tables

J -	Estimated value
U -	The analyte was analyzed for, but was not detected above the level of the associated reported quantitation limit
T -	Indicates that a quality control parameter has exceeded laboratory limits
NA -	Compound was not analyzed for by laboratory
ft bls -	Feet below land surface
mg/kg -	Milligrams per kilogram
ng/g -	Nanograms per gram
NYSDEC -	New York State Department of Environmental Conservation
SCO -	Soil Cleanup Objectives
--	No SCO available

Bold data indicates that parameter was detected above the NYSDEC Part 375 Unrestricted Use SCO

Shaded data indicates that parameter was detected above the NYSDEC Part 375 Restricted Residential SCO

Red data indicates that parameter was detected above the NYSDEC Part 375 Protection of Groundwater SCO

Groundwater Tables

J -	Estimated Value
U -	The analyte was analyzed for, but was not detected above the level of the associated reported quantitation limit
F -	The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration
NA -	Compound was not analyzed for by laboratory
µg/L -	Micrograms per liter
ng/L -	Nanogram per liter
NYSDEC -	New York State Department of Environmental Conservation
AWQSGVs -	Ambient Water-Quality Standards and Guidance Values
--	No NYSDEC AWQSGV available

Bold data indicates that parameter was detected above the NYSDEC AWQSGVs

Soil Vapor/Ambient Air

U -	The analyte was analyzed for, but was not detected above the level of the associated reported quantitation limit
ug/m3 -	Micrograms per cubic meter

Bold data indicates that parameter was detected

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-1	SB-1	SB-2	SB-2	SB-3
					Sample Date:	2/6/2023	2/6/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	15 - 17	0 - 2	20 - 22	0 - 2
1,1,1,2-Tetrachloroethane	--	--	--	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
1,1,1-Trichloroethane	0.68	100	0.68	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
1,1,2,2-Tetrachloroethane	--	--	--	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
1,1,2-Trichloroethane	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
1,1-Dichloroethane	0.27	26	0.27	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
1,1-Dichloroethene	0.33	100	0.33	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
1,1-Dichloropropene	--	--	--	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
1,2,3-Trichlorobenzene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
1,2,3-Trichloropropane	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
1,2,4,5-Tetramethylbenzene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	1.3	0.0026 U
1,2,4-Trichlorobenzene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
1,2,4-Trimethylbenzene	**3.6**	52	3.6	mg/kg		0.0026 U	0.0021 U	0.003 U	**4**	0.0026 U
1,2-Dibromoethane	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
1,2-Dichloroethane	0.02	3.1	0.02	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
1,2-Dichloroethene (total)	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
1,2-Dichloropropane	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
1,3,5-Trimethylbenzene	8.4	52	8.4	mg/kg		0.0026 U	0.0021 U	0.003 U	1.2	0.0026 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
1,3-Dichloropropane	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
1,3-Dichloropropene	--	--	--	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
1,4-Diethylbenzene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.33	0.0026 U
1,4-Dioxane	0.1	13	0.1	mg/kg		0.11 U	0.082 U	0.12 U	4.7 U	0.1 U
2,2-Dichloropropane	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
2-Butanone (MEK)	0.12	100	0.12	mg/kg		0.013 U	0.01 U	0.015 U	0.59 U	0.013 U
2-Hexanone	--	--	--	mg/kg		0.013 U	0.01 U	0.015 U	0.59 U	0.013 U
4-Ethyltoluene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.98	0.0026 U
4-Methyl-2-pentanone (MIBK)	--	--	--	mg/kg		0.013 U	0.01 U	0.015 U	0.59 U	0.013 U
Acetone	**0.05**	100	0.05	mg/kg		0.013 U	0.027	0.015 U	0.59 U	0.0067 J
Acrylonitrile	--	--	--	mg/kg		0.0053 U	0.0041 U	0.0059 U	0.24 U	0.0051 U
Benzene	0.06	4.8	0.06	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
Bromobenzene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
Bromochloromethane	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
Bromodichloromethane	--	--	--	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
Bromoform	--	--	--	mg/kg		0.0053 U	0.0041 U	0.0059 U	0.24 U	0.0051 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-1	SB-1	SB-2	SB-2	SB-3
					Sample Date:	2/6/2023	2/6/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	15 - 17	0 - 2	20 - 22	0 - 2
Bromomethane	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
Carbon disulfide	--	--	--	mg/kg		0.013 U	0.01 U	0.015 U	0.59 U	0.013 U
Carbon tetrachloride	0.76	2.4	0.76	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
Chlorobenzene	1.1	100	1.1	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
Chloroethane	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
Chloroform	0.37	49	0.37	mg/kg		0.002 U	0.0015 U	0.0022 U	0.088 U	0.0019 U
Chloromethane	--	--	--	mg/kg		0.0053 U	0.0041 U	0.0059 U	0.24 U	0.0051 U
cis-1,2-Dichloroethene	0.25	100	0.25	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
cis-1,3-Dichloropropene	--	--	--	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
Dibromochloromethane	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
Dibromochloropropane	--	--	--	mg/kg		0.004 U	0.0031 U	0.0044 U	0.18 U	0.0038 U
Dibromomethane	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
Dichlorodifluoromethane	--	--	--	mg/kg		0.013 U	0.01 U	0.015 U	0.59 U	0.013 U
Diethyl Ether	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
Ethylbenzene	1	41	1	mg/kg		0.0013 U	0.001 U	0.0015 U	0.05 J	0.0013 U
Hexachlorobutadiene	--	--	--	mg/kg		0.0053 U	0.0041 U	0.0059 U	0.24 U	0.0051 U
Isopropylbenzene	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.17	0.0013 U
m+p-Xylene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.25	0.0026 U
Methylene chloride	0.05	100	0.05	mg/kg		0.0066 U	0.0052 U	0.0074 U	0.29 U	0.0064 U
MTBE	0.93	100	0.93	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
Naphthalene	12	100	12	mg/kg		0.0053 U	0.0041 U	0.0059 U	1.6	0.0051 U
n-Butylbenzene	12	100	12	mg/kg		0.0013 U	0.001 U	0.0015 U	0.51	0.0013 U
n-Propylbenzene	3.9	100	3.9	mg/kg		0.0013 U	0.001 U	0.0015 U	0.28	0.0013 U
o-Chlorotoluene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
o-Xylene	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.15	0.0013 U
p-Chlorotoluene	--	--	--	mg/kg		0.0026 U	0.0021 U	0.003 U	0.12 U	0.0026 U
p-Isopropyltoluene	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.41	0.0013 U
sec-Butylbenzene	11	100	11	mg/kg		0.0013 U	0.001 U	0.0015 U	0.58	0.0013 U
Styrene	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
tert-Butylbenzene	5.9	100	5.9	mg/kg		0.0026 U	0.0021 U	0.003 U	0.017 J	0.0026 U
Tetrachloroethene	1.3	19	1.3	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U
Toluene	0.7	100	0.7	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
trans-1,2-Dichloroethene	0.19	100	0.19	mg/kg		0.002 U	0.0015 U	0.0022 U	0.088 U	0.0019 U
trans-1,3-Dichloropropene	--	--	--	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
trans-1,4-Dichloro-2-butene	--	--	--	mg/kg		0.0066 U	0.0052 U	0.0074 U	0.29 U	0.0064 U
Trichloroethene	0.47	21	0.47	mg/kg		0.00066 U	0.00052 U	0.00074 U	0.029 U	0.00064 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-1 2/6/2023 0 - 2	SB-1 2/6/2023 15 - 17	SB-2 2/7/2023 0 - 2	SB-2 2/7/2023 20 - 22	SB-3 2/7/2023 0 - 2
Trichlorofluoromethane	--	--	--	mg/kg		0.0053 U	0.0041 U	0.0059 U	0.24 U	0.0051 U
Vinyl acetate	--	--	--	mg/kg		0.013 U	0.01 U	0.015 U	0.59 U	0.013 U
Vinyl chloride	0.02	0.9	0.02	mg/kg		0.0013 U	0.001 U	0.0015 U	0.059 U	0.0013 U
Xylenes (total)	**0.26**	100	1.6	mg/kg		0.0013 U	0.001 U	0.0015 U	**0.4**	0.0013 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-3	SB-4	SB-4	SB-5	SB-5
					Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/6/2023	2/6/2023
					Sample Depth (ft bls):	18 - 20	0 - 2	18 - 20	0 - 2	15 - 17
1,1,1,2-Tetrachloroethane	--	--	--	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
1,1,1-Trichloroethane	0.68	100	0.68	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
1,1,2,2-Tetrachloroethane	--	--	--	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
1,1,2-Trichloroethane	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
1,1-Dichloroethane	0.27	26	0.27	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
1,1-Dichloroethene	0.33	100	0.33	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
1,1-Dichloropropene	--	--	--	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
1,2,3-Trichlorobenzene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,2,3-Trichloropropane	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,2,4,5-Tetramethylbenzene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.051
1,2,4-Trichlorobenzene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,2,4-Trimethylbenzene	**3.6**	52	3.6	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.00051 J
1,2-Dibromoethane	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,2-Dichloroethane	0.02	3.1	0.02	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
1,2-Dichloroethene (total)	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
1,2-Dichloropropane	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
1,3,5-Trimethylbenzene	8.4	52	8.4	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,3-Dichloropropane	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,3-Dichloropropene	--	--	--	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
1,4-Diethylbenzene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.016
1,4-Dioxane	0.1	13	0.1	mg/kg		0.1 U	0.11 U	0.08 U	0.14 U	0.083 U
2,2-Dichloropropane	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
2-Butanone (MEK)	0.12	100	0.12	mg/kg		0.013 U	0.014 U	0.0057 J	0.018 U	0.01 U
2-Hexanone	--	--	--	mg/kg		0.013 U	0.014 U	0.0099 U	0.018 U	0.01 U
4-Ethyltoluene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0004 J
4-Methyl-2-pentanone (MIBK)	--	--	--	mg/kg		0.013 U	0.014 U	0.0099 U	0.018 U	0.01 U
Acetone	**0.05**	100	0.05	mg/kg		0.008 J	0.014 U	0.038	0.01 J	0.013
Acrylonitrile	--	--	--	mg/kg		0.0051 U	0.0056 U	0.004 U	0.0071 U	0.0042 U
Benzene	0.06	4.8	0.06	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
Bromobenzene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Bromochloromethane	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Bromodichloromethane	--	--	--	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
Bromoform	--	--	--	mg/kg		0.0051 U	0.0056 U	0.004 U	0.0071 U	0.0042 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-3	SB-4	SB-4	SB-5	SB-5
					Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/6/2023	2/6/2023
					Sample Depth (ft bls):	18 - 20	0 - 2	18 - 20	0 - 2	15 - 17
Bromomethane	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Carbon disulfide	--	--	--	mg/kg		0.013 U	0.014 U	0.0099 U	0.018 U	0.01 U
Carbon tetrachloride	0.76	2.4	0.76	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
Chlorobenzene	1.1	100	1.1	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
Chloroethane	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Chloroform	0.37	49	0.37	mg/kg		0.0019 U	0.0021 U	0.0015 U	0.0027 U	0.0016 U
Chloromethane	--	--	--	mg/kg		0.0051 U	0.0056 U	0.004 U	0.0071 U	0.0042 U
cis-1,2-Dichloroethene	0.25	100	0.25	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
cis-1,3-Dichloropropene	--	--	--	mg/kg		0.00064 U	0.0007 U	0.0005 U	0.00089 U	0.00052 U
Dibromochloromethane	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
Dibromochloropropane	--	--	--	mg/kg		0.0038 U	0.0042 U	0.003 U	0.0053 U	0.0031 U
Dibromomethane	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Dichlorodifluoromethane	--	--	--	mg/kg		0.013 U	0.014 U	0.0099 U	0.018 U	0.01 U
Diethyl Ether	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Ethylbenzene	1	41	1	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.0008 J
Hexachlorobutadiene	--	--	--	mg/kg		0.0051 U	0.0056 U	0.004 U	0.0071 U	0.0042 U
Isopropylbenzene	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.019
m+p-Xylene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Methylene chloride	0.05	100	0.05	mg/kg		0.0064 U	0.007 U	0.005 U	0.0089 U	0.0052 U
MTBE	0.93	100	0.93	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
Naphthalene	12	100	12	mg/kg		0.0051 U	0.0016 J	0.004 U	0.0071 U	0.086
n-Butylbenzene	12	100	12	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.028
n-Propylbenzene	3.9	100	3.9	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.033
o-Chlorotoluene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
o-Xylene	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.0011
p-Chlorotoluene	--	--	--	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.0021 U
p-Isopropyltoluene	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
sec-Butylbenzene	11	100	11	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.031
Styrene	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
tert-Butylbenzene	5.9	100	5.9	mg/kg		0.0025 U	0.0028 U	0.002 U	0.0036 U	0.001 J
Tetrachloroethene	1.3	19	1.3	mg/kg		0.00064 U	0.0003 J	0.0005 U	0.00089 U	0.00052 U
Toluene	0.7	100	0.7	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
trans-1,2-Dichloroethene	0.19	100	0.19	mg/kg		0.0019 U	0.0021 U	0.0015 U	0.0027 U	0.0016 U
trans-1,3-Dichloropropene	--	--	--	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
trans-1,4-Dichloro-2-butene	--	--	--	mg/kg		0.0064 U	0.007 U	0.005 U	0.0089 U	0.0052 U
Trichloroethene	0.47	21	0.47	mg/kg		0.00064 U	0.00038 J	0.0005 U	0.00089 U	0.00052 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-3 2/7/2023 18 - 20	SB-4 2/7/2023 0 - 2	SB-4 2/7/2023 18 - 20	SB-5 2/6/2023 0 - 2	SB-5 2/6/2023 15 - 17
Trichlorofluoromethane	--	--	--	mg/kg		0.0051 U	0.0056 U	0.004 U	0.0071 U	0.0042 U
Vinyl acetate	--	--	--	mg/kg		0.013 U	0.014 U	0.0099 U	0.018 U	0.01 U
Vinyl chloride	0.02	0.9	0.02	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.001 U
Xylenes (total)	**0.26**	100	1.6	mg/kg		0.0013 U	0.0014 U	0.00099 U	0.0018 U	0.0011

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-6	SB-6	SB-7	SB-7	SB-8
					Sample Date:	2/6/2023	2/6/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	22 - 24	12 - 14	6 - 8	0 - 2
1,1,1,2-Tetrachloroethane	--	--	--	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
1,1,1-Trichloroethane	0.68	100	0.68	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
1,1,2,2-Tetrachloroethane	--	--	--	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
1,1,2-Trichloroethane	--	--	--	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
1,1-Dichloroethane	0.27	26	0.27	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
1,1-Dichloroethene	0.33	100	0.33	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
1,1-Dichloropropene	--	--	--	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
1,2,3-Trichlorobenzene	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
1,2,3-Trichloropropane	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
1,2,4,5-Tetramethylbenzene	--	--	--	mg/kg		0.0027 U	0.046	0.0027 U	0.0027 U	0.0038 U
1,2,4-Trichlorobenzene	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
1,2,4-Trimethylbenzene	**3.6**	52	3.6	mg/kg		0.0027 U	0.027	0.0027 U	0.0027 U	0.0038 U
1,2-Dibromoethane	--	--	--	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
1,2-Dichloroethane	0.02	3.1	0.02	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
1,2-Dichloroethene (total)	--	--	--	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
1,2-Dichloropropane	--	--	--	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
1,3,5-Trimethylbenzene	8.4	52	8.4	mg/kg		0.0027 U	0.00037 J	0.0027 U	0.0027 U	0.0038 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
1,3-Dichloropropane	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
1,3-Dichloropropene	--	--	--	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
1,4-Diethylbenzene	--	--	--	mg/kg		0.0027 U	0.015	0.0027 U	0.0027 U	0.0038 U
1,4-Dioxane	0.1	13	0.1	mg/kg		0.11 U	0.11 U	0.11 U	0.11 U	0.15 U
2,2-Dichloropropane	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
2-Butanone (MEK)	0.12	100	0.12	mg/kg		0.014 U	0.014 U	0.014 U	0.014 U	0.019 U
2-Hexanone	--	--	--	mg/kg		0.014 U	0.014 U	0.014 U	0.014 U	0.019 U
4-Ethyltoluene	--	--	--	mg/kg		0.0027 U	0.0082	0.0027 U	0.0027 U	0.0038 U
4-Methyl-2-pentanone (MIBK)	--	--	--	mg/kg		0.014 U	0.014 U	0.014 U	0.014 U	0.019 U
Acetone	**0.05**	100	0.05	mg/kg		0.0097 J	0.024	0.0077 J	0.014 U	0.034
Acrylonitrile	--	--	--	mg/kg		0.0054 U	0.0055 U	0.0055 U	0.0055 U	0.0077 U
Benzene	0.06	4.8	0.06	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
Bromobenzene	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Bromochloromethane	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Bromodichloromethane	--	--	--	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
Bromoform	--	--	--	mg/kg		0.0054 U	0.0055 U	0.0055 U	0.0055 U	0.0077 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-6	SB-6	SB-7	SB-7	SB-8
					Sample Date:	2/6/2023	2/6/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	22 - 24	12 - 14	6 - 8	0 - 2
Bromomethane	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Carbon disulfide	--	--	--	mg/kg		0.014 U	0.014 U	0.014 U	0.014 U	0.019 U
Carbon tetrachloride	0.76	2.4	0.76	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
Chlorobenzene	1.1	100	1.1	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
Chloroethane	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Chloroform	0.37	49	0.37	mg/kg		0.002 U	0.002 U	0.002 U	0.002 U	0.0029 U
Chloromethane	--	--	--	mg/kg		0.0054 U	0.0055 U	0.0055 U	0.0055 U	0.0077 U
cis-1,2-Dichloroethene	0.25	100	0.25	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
cis-1,3-Dichloropropene	--	--	--	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00068 U	0.00096 U
Dibromochloromethane	--	--	--	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
Dibromochloropropane	--	--	--	mg/kg		0.0041 U	0.0041 U	0.0041 U	0.0041 U	0.0058 U
Dibromomethane	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Dichlorodifluoromethane	--	--	--	mg/kg		0.014 U	0.014 U	0.014 U	0.014 U	0.019 U
Diethyl Ether	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Ethylbenzene	1	41	1	mg/kg		0.0014 U	0.0031	0.0014 U	0.0014 U	0.0019 U
Hexachlorobutadiene	--	--	--	mg/kg		0.0054 U	0.0055 U	0.0055 U	0.0055 U	0.0077 U
Isopropylbenzene	--	--	--	mg/kg		0.0014 U	0.0075	0.0014 U	0.0014 U	0.0019 U
m+p-Xylene	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Methylene chloride	0.05	100	0.05	mg/kg		0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0096 U
MTBE	0.93	100	0.93	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
Naphthalene	12	100	12	mg/kg		0.0024 J	0.055	0.0055 U	0.0011 J	0.0077 U
n-Butylbenzene	12	100	12	mg/kg		0.0014 U	0.019	0.0014 U	0.0014 U	0.0019 U
n-Propylbenzene	3.9	100	3.9	mg/kg		0.0014 U	0.016	0.0014 U	0.0014 U	0.0019 U
o-Chlorotoluene	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
o-Xylene	--	--	--	mg/kg		0.0014 U	0.00043 J	0.0014 U	0.0014 U	0.0019 U
p-Chlorotoluene	--	--	--	mg/kg		0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0038 U
p-Isopropyltoluene	--	--	--	mg/kg		0.0014 U	0.0079	0.0014 U	0.0014 U	0.0019 U
sec-Butylbenzene	11	100	11	mg/kg		0.0014 U	0.018	0.0014 U	0.0014 U	0.0019 U
Styrene	--	--	--	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
tert-Butylbenzene	5.9	100	5.9	mg/kg		0.0027 U	0.00068 J	0.0027 U	0.0027 U	0.0038 U
Tetrachloroethene	1.3	19	1.3	mg/kg		0.00068 U	0.00068 U	0.00068 U	0.00083	0.00096 U
Toluene	0.7	100	0.7	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
trans-1,2-Dichloroethene	0.19	100	0.19	mg/kg		0.002 U	0.002 U	0.002 U	0.002 U	0.0029 U
trans-1,3-Dichloropropene	--	--	--	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
trans-1,4-Dichloro-2-butene	--	--	--	mg/kg		0.0068 U	0.0068 U	0.0068 U	0.0068 U	0.0096 U
Trichloroethene	0.47	21	0.47	mg/kg		0.00068 U	0.00068 U	0.00045 J	0.00096	0.00096 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-6 2/6/2023 0 - 2	SB-6 2/6/2023 22 - 24	SB-7 2/7/2023 12 - 14	SB-7 2/7/2023 6 - 8	SB-8 2/7/2023 0 - 2
Trichlorofluoromethane	--	--	--	mg/kg		0.0054 U	0.0055 U	0.0055 U	0.0055 U	0.0077 U
Vinyl acetate	--	--	--	mg/kg		0.014 U	0.014 U	0.014 U	0.014 U	0.019 U
Vinyl chloride	0.02	0.9	0.02	mg/kg		0.0014 U	0.0014 U	0.0014 U	0.0014 U	0.0019 U
Xylenes (total)	**0.26**	100	1.6	mg/kg		0.0014 U	0.00043 J	0.0014 U	0.0014 U	0.0019 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-8
					Sample Date:	2/7/2023
					Sample Depth (ft bls):	10 - 12
1,1,1,2-Tetrachloroethane	--	--	--	mg/kg		0.00051 U
1,1,1-Trichloroethane	0.68	100	0.68	mg/kg		0.00051 U
1,1,2,2-Tetrachloroethane	--	--	--	mg/kg		0.00051 U
1,1,2-Trichloroethane	--	--	--	mg/kg		0.001 U
1,1-Dichloroethane	0.27	26	0.27	mg/kg		0.001 U
1,1-Dichloroethene	0.33	100	0.33	mg/kg		0.001 U
1,1-Dichloropropene	--	--	--	mg/kg		0.00051 U
1,2,3-Trichlorobenzene	--	--	--	mg/kg		0.002 U
1,2,3-Trichloropropane	--	--	--	mg/kg		0.002 U
1,2,4,5-Tetramethylbenzene	--	--	--	mg/kg		0.094
1,2,4-Trichlorobenzene	--	--	--	mg/kg		0.002 U
1,2,4-Trimethylbenzene	**3.6**	52	3.6	mg/kg		0.00047 J
1,2-Dibromoethane	--	--	--	mg/kg		0.001 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		0.002 U
1,2-Dichloroethane	0.02	3.1	0.02	mg/kg		0.001 U
1,2-Dichloroethene (total)	--	--	--	mg/kg		0.001 U
1,2-Dichloropropane	--	--	--	mg/kg		0.001 U
1,3,5-Trimethylbenzene	8.4	52	8.4	mg/kg		0.002 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		0.002 U
1,3-Dichloropropane	--	--	--	mg/kg		0.002 U
1,3-Dichloropropene	--	--	--	mg/kg		0.00051 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		0.002 U
1,4-Diethylbenzene	--	--	--	mg/kg		0.008
1,4-Dioxane	0.1	13	0.1	mg/kg		0.082 U
2,2-Dichloropropane	--	--	--	mg/kg		0.002 U
2-Butanone (MEK)	0.12	100	0.12	mg/kg		0.013
2-Hexanone	--	--	--	mg/kg		0.01 U
4-Ethyltoluene	--	--	--	mg/kg		0.002 U
4-Methyl-2-pentanone (MIBK)	--	--	--	mg/kg		0.01 U
Acetone	**0.05**	100	0.05	mg/kg		**0.054**
Acrylonitrile	--	--	--	mg/kg		0.0041 U
Benzene	0.06	4.8	0.06	mg/kg		0.00051 U
Bromobenzene	--	--	--	mg/kg		0.002 U
Bromochloromethane	--	--	--	mg/kg		0.002 U
Bromodichloromethane	--	--	--	mg/kg		0.00051 U
Bromoform	--	--	--	mg/kg		0.0041 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-8 2/7/2023 10 - 12
Bromomethane	--	--	--	mg/kg		0.002 U
Carbon disulfide	--	--	--	mg/kg		0.01 U
Carbon tetrachloride	0.76	2.4	0.76	mg/kg		0.001 U
Chlorobenzene	1.1	100	1.1	mg/kg		0.00051 U
Chloroethane	--	--	--	mg/kg		0.002 U
Chloroform	0.37	49	0.37	mg/kg		0.0015 U
Chloromethane	--	--	--	mg/kg		0.0041 U
cis-1,2-Dichloroethene	0.25	100	0.25	mg/kg		0.001 U
cis-1,3-Dichloropropene	--	--	--	mg/kg		0.00051 U
Dibromochloromethane	--	--	--	mg/kg		0.001 U
Dibromochloropropane	--	--	--	mg/kg		0.0031 U
Dibromomethane	--	--	--	mg/kg		0.002 U
Dichlorodifluoromethane	--	--	--	mg/kg		0.01 U
Diethyl Ether	--	--	--	mg/kg		0.002 U
Ethylbenzene	1	41	1	mg/kg		0.001 U
Hexachlorobutadiene	--	--	--	mg/kg		0.0041 U
Isopropylbenzene	--	--	--	mg/kg		0.00041 J
m+p-Xylene	--	--	--	mg/kg		0.002 U
Methylene chloride	0.05	100	0.05	mg/kg		0.0051 U
MTBE	0.93	100	0.93	mg/kg		0.002 U
Naphthalene	12	100	12	mg/kg		0.0041 U
n-Butylbenzene	12	100	12	mg/kg		0.0058
n-Propylbenzene	3.9	100	3.9	mg/kg		0.001 U
o-Chlorotoluene	--	--	--	mg/kg		0.002 U
o-Xylene	--	--	--	mg/kg		0.001 U
p-Chlorotoluene	--	--	--	mg/kg		0.002 U
p-Isopropyltoluene	--	--	--	mg/kg		0.00057 J
sec-Butylbenzene	11	100	11	mg/kg		0.0047
Styrene	--	--	--	mg/kg		0.001 U
tert-Butylbenzene	5.9	100	5.9	mg/kg		0.00041 J
Tetrachloroethene	1.3	19	1.3	mg/kg		0.00051 U
Toluene	0.7	100	0.7	mg/kg		0.001 U
trans-1,2-Dichloroethene	0.19	100	0.19	mg/kg		0.0015 U
trans-1,3-Dichloropropene	--	--	--	mg/kg		0.001 U
trans-1,4-Dichloro-2-butene	--	--	--	mg/kg		0.0051 U
Trichloroethene	0.47	21	0.47	mg/kg		0.00051 U

Table 1. Summary of Volatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-8 2/7/2023 10 - 12
Trichlorofluoromethane	--	--	--	mg/kg		0.0041 U
Vinyl acetate	--	--	--	mg/kg		0.01 U
Vinyl chloride	0.02	0.9	0.02	mg/kg		0.001 U
Xylenes (total)	**0.26**	100	1.6	mg/kg		0.001 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	RXSB-1	RXSB-2	RXSB-3	SB-1	SB-1
					Sample Date:	9/26/2023	9/26/2023	9/26/2023	2/6/2023	2/6/2023
					Sample Depth (ft bls):	0 - 2	0 - 1.5	0 - 2	0 - 2	15 - 17
1,1'-Biphenyl	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.12 J	0.31 J
1,2,4,5-Tetrachlorobenzene	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
1,2,4-Trichlorobenzene	--	--	--	mg/kg		NA	NA	NA	0.17 U	0.2 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		NA	NA	NA	0.17 U	0.2 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		NA	NA	NA	0.17 U	0.2 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		NA	NA	NA	0.17 U	0.2 U
1,4-Dioxane	0.1	13	0.1	mg/kg		0.036 U	0.036 U	0.036 U	0.026 U	0.029 U
2,3,4,6-Tetrachlorophenol	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	NA	NA
2,4,5-Trichlorophenol	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
2,4,6-Trichlorophenol	--	--	--	mg/kg		0.15 U	0.14 U	0.14 U	0.1 U	0.12 U
2,4-Dichlorophenol	--	--	--	mg/kg		0.15 U	0.14 U	0.14 U	0.16 U	0.18 U
2,4-Dimethylphenol	--	--	--	mg/kg		0.36 UT	0.36 UT	0.36 UT	0.17 U	0.2 U
2,4-Dinitrophenol	--	--	--	mg/kg		0.29 U	0.29 U	0.29 U	0.83 U	0.94 U
2,4-Dinitrotoluene	--	--	--	mg/kg		0.074 U	0.072 U	0.072 U	0.17 U	0.2 U
2,6-Dinitrotoluene	--	--	--	mg/kg		0.074 U	0.072 U	0.072 U	0.17 U	0.2 U
2-Chloronaphthalene	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
2-Chlorophenol	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
2-Methylnaphthalene	--	--	--	mg/kg		0.014 J	0.030 J	0.36 U	0.39	1.3
2-Methylphenol	0.33	100	0.33	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.034 J
2-Nitroaniline	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
2-Nitrophenol	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.38 U	0.42 U
3&4-Methylphenol	0.33	100	0.33	mg/kg		0.36 U	0.36 U	0.36 U	0.031 J	0.12 J
3,3'-Dichlorobenzidine	--	--	--	mg/kg		0.15 U	0.14 U	0.14 U	0.17 U	0.2 U
3-Nitroaniline	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
4,6-Dinitro-2-methylphenol	--	--	--	mg/kg		0.29 U	0.29 U	0.29 U	0.45 U	0.51 U
4-Bromophenyl phenyl ether	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
4-Chloro-3-methylphenol	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
4-Chloroaniline	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
4-Chlorophenyl phenyl ether	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
4-Methylphenol	0.33	100	0.33	mg/kg		0.36 U	0.36 U	0.36 U	NA	NA
4-Nitroaniline	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
4-Nitrophenol	--	--	--	mg/kg		0.74 U	0.72 U	0.72 U	0.24 U	0.27 U
Acenaphthene	20	100	98	mg/kg		0.040 J	0.15 J	0.018 J	1.8	2.5
Acenaphthylene	100	100	107	mg/kg		0.047 J	0.098 J	0.013 J	0.46	1.1
Acetophenone	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
Anthracene	100	100	1000	mg/kg		0.11 J	0.39	0.052 J	3.9	5.4

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	RXSB-1	RXSB-2	RXSB-3	SB-1	SB-1
					Sample Date:	9/26/2023	9/26/2023	9/26/2023	2/6/2023	2/6/2023
					Sample Depth (ft bls):	0 - 2	0 - 1.5	0 - 2	0 - 2	15 - 17
Atrazine	--	--	--	mg/kg		0.15 UT	0.14 UT	0.14 UT	NA	NA
Benzaldehyde	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	NA	NA
Benzo[a]anthracene	**1**	1	1	mg/kg		0.58	**1.5**	0.22	**8.2**	**8.8**
Benzo[a]pyrene	**1**	1	22	mg/kg		0.66	**1.6**	0.23	**8**	**8.5**
Benzo[b]fluoranthene	**1**	1	1.7	mg/kg		0.94	**2.2**	0.27	**9.8**	**9.1**
Benzo[g,h,i]perylene	100	100	1000	mg/kg		0.30 J	0.73	0.11 J	4.7	4.8
Benzo[k]fluoranthene	**0.8**	3.9	1.7	mg/kg		0.35	0.78	0.11	**2.1**	**1.8**
Benzoic Acid	--	--	--	mg/kg		NA	NA	NA	0.56 U	0.63 U
Benzyl Alcohol	--	--	--	mg/kg		NA	NA	NA	0.17 U	0.2 U
Bis(2-chloro-1-methylethyl)ether	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.21 U	0.23 U
Bis(2-chloroethoxy)methane	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.19 U	0.21 U
Bis(2-chloroethyl) ether	--	--	--	mg/kg		0.036 U	0.036 U	0.036 U	0.16 U	0.18 U
Bis(2-ethylhexyl) phthalate	--	--	--	mg/kg		0.36 U	0.26 J	0.36 U	0.17 U	0.2 U
Butylbenzyl phthalate	--	--	--	mg/kg		0.36 U	0.031 J	0.36 U	0.17 U	0.2 U
Caprolactam	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	NA	NA
Carbazole	--	--	--	mg/kg		0.058 J	0.22 J	0.021 J	2	2.5
Chrysene	**1**	3.9	1	mg/kg		0.62	**1.4**	0.23 J	**8**	**8.9**
Dibenzo[a,h]anthracene	**0.33**	0.33	1000	mg/kg		0.079	0.17	0.032 J	**0.81**	**1**
Dibenzofuran	7	59	210	mg/kg		0.020 J	0.075 J	0.36 U	1	1.9
Diethyl phthalate	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
Dimethyl phthalate	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
Di-n-butyl phthalate	--	--	--	mg/kg		0.36 U	0.017 J	0.36 U	0.17 U	0.2 U
Di-n-octyl phthalate	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
Fluoranthene	100	100	1000	mg/kg		0.94	3.1	0.42	20	22
Fluorene	30	100	386	mg/kg		0.035 J	0.12 J	0.011 J	1.6	2.3
Hexachlorobenzene	0.33	1.2	3.2	mg/kg		0.036 U	0.036 U	0.036 U	0.1 U	0.12 U
Hexachlorobutadiene	--	--	--	mg/kg		0.074 U	0.072 U	0.072 U	0.17 U	0.2 U
Hexachlorocyclopentadiene	--	--	--	mg/kg		0.36 UT	0.36 UT	0.36 UT	0.5 U	0.56 U
Hexachloroethane	--	--	--	mg/kg		0.036 U	0.036 U	0.036 U	0.14 U	0.16 U
Indeno[1,2,3-cd]pyrene	**0.5**	0.5	8.2	mg/kg		0.36	**0.87**	0.14	**5.5**	**5.7**
Isophorone	--	--	--	mg/kg		0.15 U	0.14 U	0.14 U	0.16 U	0.18 U
Naphthalene	12	100	12	mg/kg		0.024 J	0.056 J	0.0082 J	0.85	2
Nitrobenzene	--	--	--	mg/kg		0.036 U	0.036 U	0.036 U	0.16 U	0.18 U
n-Nitrosodi-n-propylamine	--	--	--	mg/kg		0.036 U	0.036 U	0.036 U	0.17 U	0.2 U
n-Nitrosodiphenylamine	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.14 U	0.16 U
Pentachlorophenol	0.8	6.7	0.8	mg/kg		0.29 U	0.29 U	0.29 U	0.14 U	0.16 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	RXSB-1	RXSB-2	RXSB-3	SB-1	SB-1
					Sample Date:	9/26/2023	9/26/2023	9/26/2023	2/6/2023	2/6/2023
					Sample Depth (ft bls):	0 - 2	0 - 1.5	0 - 2	0 - 2	15 - 17
Phenanthrene	100	100	1000	mg/kg		0.56	1.9	0.26 J	16	23
Phenols (Total)	--	--	--	mg/kg		0.36 U	0.36 U	0.36 U	0.17 U	0.2 U
Pyrene	100	100	1000	mg/kg		0.92	2.9	0.42	16	20

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-2	SB-2	SB-3	SB-3	SB-4	SB-4
					Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	20 - 22	0 - 2	18 - 20	0 - 2	18 - 20
1,1'-Biphenyl	--	--	--	mg/kg		0.41 U	0.44 U	0.4 U	0.4 U	0.12 J	0.42 U
1,2,4,5-Tetrachlorobenzene	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
1,2,4-Trichlorobenzene	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
1,4-Dioxane	0.1	13	0.1	mg/kg		0.027 U	0.029 U	0.026 U	0.026 U	0.028 U	0.028 U
2,3,4,6-Tetrachlorophenol	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
2,4,6-Trichlorophenol	--	--	--	mg/kg		0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
2,4-Dichlorophenol	--	--	--	mg/kg		0.16 U	0.17 U	0.16 U	0.16 U	0.17 U	0.17 U
2,4-Dimethylphenol	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
2,4-Dinitrophenol	--	--	--	mg/kg		0.86 U	0.92 U	0.84 U	0.83 U	0.9 U	0.89 U
2,4-Dinitrotoluene	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
2,6-Dinitrotoluene	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
2-Chloronaphthalene	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
2-Chlorophenol	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
2-Methylnaphthalene	--	--	--	mg/kg		0.22 U	0.1 J	0.097 J	0.21 U	0.46	0.22 U
2-Methylphenol	0.33	100	0.33	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.031 J	0.18 U
2-Nitroaniline	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
2-Nitrophenol	--	--	--	mg/kg		0.39 U	0.41 U	0.38 U	0.37 U	0.4 U	0.4 U
3&4-Methylphenol	0.33	100	0.33	mg/kg		0.26 U	0.28 U	0.25 U	0.25 U	0.098 J	0.27 U
3,3'-Dichlorobenzidine	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
3-Nitroaniline	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
4,6-Dinitro-2-methylphenol	--	--	--	mg/kg		0.47 U	0.5 U	0.45 U	0.45 U	0.49 U	0.48 U
4-Bromophenyl phenyl ether	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
4-Chloro-3-methylphenol	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
4-Chloroaniline	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
4-Chlorophenyl phenyl ether	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
4-Methylphenol	0.33	100	0.33	mg/kg		NA	NA	NA	NA	NA	NA
4-Nitroaniline	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
4-Nitrophenol	--	--	--	mg/kg		0.25 U	0.27 U	0.24 U	0.24 U	0.26 U	0.26 U
Acenaphthene	20	100	98	mg/kg		0.14 U	0.15 U	0.16	0.14 U	0.98	0.15 U
Acenaphthylene	100	100	107	mg/kg		0.14 U	0.15 U	0.25	0.14 U	1.5	0.15 U
Acetophenone	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
Anthracene	100	100	1000	mg/kg		0.11 U	0.11 U	0.58	0.1 U	3	0.11 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-2	SB-2	SB-3	SB-3	SB-4	SB-4
					Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	20 - 22	0 - 2	18 - 20	0 - 2	18 - 20
Atrazine	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
Benzaldehyde	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
Benzo[a]anthracene	**1**	1	1	mg/kg		0.052 J	0.11 U	**2**	0.039 J	**7.2**	0.11 U
Benzo[a]pyrene	**1**	1	22	mg/kg		0.044 J	0.15 U	**1.7**	0.14 U	**6.9**	0.15 U
Benzo[b]fluoranthene	**1**	1	1.7	mg/kg		0.049 J	0.11 U	**2.1**	0.031 J	**8.5**	0.11 U
Benzo[g,h,i]perylene	100	100	1000	mg/kg		0.028 J	0.15 U	1.2	0.14 U	4.1	0.15 U
Benzo[k]fluoranthene	**0.8**	3.9	1.7	mg/kg		0.11 U	0.11 U	0.67	0.1 U	**1.4**	0.11 U
Benzoic Acid	--	--	--	mg/kg		0.58 U	0.62 U	0.57 U	0.56 U	0.6 U	0.6 U
Benzyl Alcohol	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
Bis(2-chloro-1-methylethyl)ether	--	--	--	mg/kg		0.22 U	0.23 U	0.21 U	0.21 U	0.22 U	0.22 U
Bis(2-chloroethoxy)methane	--	--	--	mg/kg		0.19 U	0.21 U	0.19 U	0.19 U	0.2 U	0.2 U
Bis(2-chloroethyl) ether	--	--	--	mg/kg		0.16 U	0.17 U	0.16 U	0.16 U	0.17 U	0.17 U
Bis(2-ethylhexyl) phthalate	--	--	--	mg/kg		0.18 U	0.19 U	0.1 J	0.17 U	0.43	0.18 U
Butylbenzyl phthalate	--	--	--	mg/kg		0.18 U	0.19 U	0.056 J	0.17 U	0.19 U	0.18 U
Caprolactam	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
Carbazole	--	--	--	mg/kg		0.18 U	0.19 U	0.31	0.17 U	1.4	0.18 U
Chrysene	**1**	3.9	1	mg/kg		0.043 J	0.11 U	**1.8**	0.033 J	**7.2**	0.11 U
Dibenzo[a,h]anthracene	**0.33**	0.33	1000	mg/kg		0.11 U	0.11 U	0.27	0.1 U	**0.99**	0.11 U
Dibenzofuran	7	59	210	mg/kg		0.18 U	0.19 U	0.13 J	0.17 U	0.83	0.18 U
Diethyl phthalate	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
Dimethyl phthalate	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
Di-n-butyl phthalate	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.071 J	0.18 U
Di-n-octyl phthalate	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
Fluoranthene	100	100	1000	mg/kg		0.1 J	0.11 U	4.1	0.054 J	15	0.11 U
Fluorene	30	100	386	mg/kg		0.18 U	0.021 J	0.14 J	0.17 U	1.2	0.18 U
Hexachlorobenzene	0.33	1.2	3.2	mg/kg		0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.11 U
Hexachlorobutadiene	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
Hexachlorocyclopentadiene	--	--	--	mg/kg		0.52 U	0.55 U	0.5 U	0.5 U	0.53 U	0.53 U
Hexachloroethane	--	--	--	mg/kg		0.14 U	0.15 U	0.14 U	0.14 U	0.15 U	0.15 U
Indeno[1,2,3-cd]pyrene	**0.5**	0.5	8.2	mg/kg		0.031 J	0.15 U	**1.3**	0.14 U	**4.9**	0.15 U
Isophorone	--	--	--	mg/kg		0.16 U	0.17 U	0.16 U	0.16 U	0.17 U	0.17 U
Naphthalene	12	100	12	mg/kg		0.18 U	0.19 U	0.18	0.17 U	0.77	0.18 U
Nitrobenzene	--	--	--	mg/kg		0.16 U	0.17 U	0.16 U	0.16 U	0.17 U	0.17 U
n-Nitrosodi-n-propylamine	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.19 U	0.18 U
n-Nitrosodiphenylamine	--	--	--	mg/kg		0.14 U	0.15 U	0.14 U	0.14 U	0.15 U	0.15 U
Pentachlorophenol	0.8	6.7	0.8	mg/kg		0.14 U	0.15 U	0.14 U	0.14 U	0.15 U	0.15 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-2 2/7/2023 0 - 2	SB-2 2/7/2023 20 - 22	SB-3 2/7/2023 0 - 2	SB-3 2/7/2023 18 - 20	SB-4 2/7/2023 0 - 2	SB-4 2/7/2023 18 - 20
Phenanthrene	100	100	1000	mg/kg		0.07 J	0.041 J	2.4	0.031 J	11	0.11 U
Phenols (Total)	--	--	--	mg/kg		0.18 U	0.19 U	0.17 U	0.17 U	0.063 J	0.18 U
Pyrene	100	100	1000	mg/kg		0.094 J	0.11 U	3.8	0.057 J	13	0.11 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-5	SB-5	SB-6	SB-6	SB-7	SB-7
					Sample Date:	2/6/2023	2/6/2023	2/6/2023	2/6/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	15 - 17	0 - 2	22 - 24	12 - 14	6 - 8
1,1'-Biphenyl	--	--	--	mg/kg		0.47 U	0.42 U	0.41 U	0.07 J	0.41 U	0.41 U
1,2,4,5-Tetrachlorobenzene	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
1,2,4-Trichlorobenzene	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
1,4-Dioxane	0.1	13	0.1	mg/kg		0.031 U	0.028 U	0.027 U	0.031 U	0.027 U	0.027 U
2,3,4,6-Tetrachlorophenol	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2,4,6-Trichlorophenol	--	--	--	mg/kg		0.12 U	0.11 U	0.11 U	0.12 U	0.11 U	0.11 U
2,4-Dichlorophenol	--	--	--	mg/kg		0.18 U	0.17 U	0.16 U	0.19 U	0.16 U	0.16 U
2,4-Dimethylphenol	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2,4-Dinitrophenol	--	--	--	mg/kg		0.98 U	0.88 U	0.87 U	1 U	0.87 U	0.87 U
2,4-Dinitrotoluene	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2,6-Dinitrotoluene	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2-Chloronaphthalene	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2-Chlorophenol	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2-Methylnaphthalene	--	--	--	mg/kg		0.032 J	0.048 J	0.026 J	0.72	0.22 U	0.044 J
2-Methylphenol	0.33	100	0.33	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2-Nitroaniline	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
2-Nitrophenol	--	--	--	mg/kg		0.44 U	0.4 U	0.39 U	0.45 U	0.39 U	0.39 U
3&4-Methylphenol	0.33	100	0.33	mg/kg		0.3 U	0.26 U	0.26 U	0.3 U	0.26 U	0.26 U
3,3'-Dichlorobenzidine	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
3-Nitroaniline	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
4,6-Dinitro-2-methylphenol	--	--	--	mg/kg		0.53 U	0.48 U	0.47 U	0.54 U	0.47 U	0.47 U
4-Bromophenyl phenyl ether	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
4-Chloro-3-methylphenol	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
4-Chloroaniline	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
4-Chlorophenyl phenyl ether	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
4-Methylphenol	0.33	100	0.33	mg/kg		NA	NA	NA	NA	NA	NA
4-Nitroaniline	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
4-Nitrophenol	--	--	--	mg/kg		0.29 U	0.26 U	0.25 U	0.29 U	0.25 U	0.25 U
Acenaphthene	20	100	98	mg/kg		0.068 J	0.15 U	0.13 J	0.056 J	0.14 U	0.13 J
Acenaphthylene	100	100	107	mg/kg		0.099 J	0.15 U	0.098 J	0.17 U	0.14 U	0.098 J
Acetophenone	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Anthracene	100	100	1000	mg/kg		0.23	0.11 U	0.36	0.12 U	0.11 U	0.47

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-5	SB-5	SB-6	SB-6	SB-7	SB-7
					Sample Date:	2/6/2023	2/6/2023	2/6/2023	2/6/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	15 - 17	0 - 2	22 - 24	12 - 14	6 - 8
Atrazine	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
Benzaldehyde	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
Benzo[a]anthracene	**1**	1	1	mg/kg		**1.3**	0.11 U	**1.2**	0.12 U	0.022 J	0.94
Benzo[a]pyrene	**1**	1	22	mg/kg		**1.2**	0.15 U	1	0.17 U	0.14 U	0.77
Benzo[b]fluoranthene	**1**	1	1.7	mg/kg		**1.5**	0.11 U	**1.3**	0.12 U	0.11 U	0.86
Benzo[g,h,i]perylene	100	100	1000	mg/kg		0.75	0.15 U	0.62	0.17 U	0.14 U	0.49
Benzo[k]fluoranthene	**0.8**	3.9	1.7	mg/kg		0.5	0.11 U	0.36	0.12 U	0.11 U	0.26
Benzoic Acid	--	--	--	mg/kg		0.66 U	0.6 U	0.59 U	0.68 U	0.58 U	0.59 U
Benzyl Alcohol	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Bis(2-chloro-1-methylethyl)ether	--	--	--	mg/kg		0.25 U	0.22 U	0.22 U	0.25 U	0.22 U	0.22 U
Bis(2-chloroethoxy)methane	--	--	--	mg/kg		0.22 U	0.2 U	0.2 U	0.22 U	0.2 U	0.2 U
Bis(2-chloroethyl) ether	--	--	--	mg/kg		0.18 U	0.17 U	0.16 U	0.19 U	0.16 U	0.16 U
Bis(2-ethylhexyl) phthalate	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Butylbenzyl phthalate	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Caprolactam	--	--	--	mg/kg		NA	NA	NA	NA	NA	NA
Carbazole	--	--	--	mg/kg		0.094 J	0.18 U	0.15 J	0.21 U	0.18 U	0.23
Chrysene	**1**	3.9	1	mg/kg		**1.3**	0.11 U	**1.2**	0.12 U	0.11 U	0.88
Dibenzo[a,h]anthracene	**0.33**	0.33	1000	mg/kg		0.19	0.11 U	0.15	0.12 U	0.11 U	0.096 J
Dibenzofuran	7	59	210	mg/kg		0.036 J	0.18 U	0.075 J	0.037 J	0.18 U	0.14 J
Diethyl phthalate	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Dimethyl phthalate	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Di-n-butyl phthalate	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Di-n-octyl phthalate	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Fluoranthene	100	100	1000	mg/kg		2.4	0.11 U	2.6	0.12 U	0.038 J	2.1
Fluorene	30	100	386	mg/kg		0.039 J	0.18 U	0.11 J	0.098 J	0.18 U	0.17 J
Hexachlorobenzene	0.33	1.2	3.2	mg/kg		0.12 U	0.11 U	0.11 U	0.12 U	0.11 U	0.11 U
Hexachlorobutadiene	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Hexachlorocyclopentadiene	--	--	--	mg/kg		0.59 U	0.53 U	0.52 U	0.6 U	0.52 U	0.52 U
Hexachloroethane	--	--	--	mg/kg		0.16 U	0.15 U	0.14 U	0.17 U	0.14 U	0.14 U
Indeno[1,2,3-cd]pyrene	**0.5**	0.5	8.2	mg/kg		**0.85**	0.15 U	**0.71**	0.17 U	0.14 U	0.5
Isophorone	--	--	--	mg/kg		0.18 U	0.17 U	0.16 U	0.19 U	0.16 U	0.16 U
Naphthalene	12	100	12	mg/kg		0.045 J	0.046 J	0.052 J	0.13 J	0.18 U	0.14 J
Nitrobenzene	--	--	--	mg/kg		0.18 U	0.17 U	0.16 U	0.19 U	0.16 U	0.16 U
n-Nitrosodi-n-propylamine	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
n-Nitrosodiphenylamine	--	--	--	mg/kg		0.16 U	0.15 U	0.14 U	0.17 U	0.14 U	0.14 U
Pentachlorophenol	0.8	6.7	0.8	mg/kg		0.16 U	0.15 U	0.14 U	0.17 U	0.14 U	0.14 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-5 2/6/2023 0 - 2	SB-5 2/6/2023 15 - 17	SB-6 2/6/2023 0 - 2	SB-6 2/6/2023 22 - 24	SB-7 2/7/2023 12 - 14	SB-7 2/7/2023 6 - 8
Phenanthrene	100	100	1000	mg/kg		1	0.11 U	1.6	0.25	0.023 J	2.1
Phenols (Total)	--	--	--	mg/kg		0.2 U	0.18 U	0.18 U	0.21 U	0.18 U	0.18 U
Pyrene	100	100	1000	mg/kg		2.1	0.11 U	2.3	0.058 J	0.033 J	2

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-8 2/7/2023 0 - 2	SB-8 2/7/2023 10 - 12
1,1'-Biphenyl	--	--	--	mg/kg		4.7 U	0.47 U
1,2,4,5-Tetrachlorobenzene	--	--	--	mg/kg		2.1 U	0.2 U
1,2,4-Trichlorobenzene	--	--	--	mg/kg		2.1 U	0.2 U
1,2-Dichlorobenzene	1.1	100	1.1	mg/kg		2.1 U	0.2 U
1,3-Dichlorobenzene	2.4	49	2.4	mg/kg		2.1 U	0.2 U
1,4-Dichlorobenzene	1.8	13	1.8	mg/kg		2.1 U	0.2 U
1,4-Dioxane	0.1	13	0.1	mg/kg		0.31 U	0.031 U
2,3,4,6-Tetrachlorophenol	--	--	--	mg/kg		NA	NA
2,4,5-Trichlorophenol	--	--	--	mg/kg		2.1 U	0.2 U
2,4,6-Trichlorophenol	--	--	--	mg/kg		1.2 U	0.12 U
2,4-Dichlorophenol	--	--	--	mg/kg		1.9 U	0.18 U
2,4-Dimethylphenol	--	--	--	mg/kg		2.1 U	0.2 U
2,4-Dinitrophenol	--	--	--	mg/kg		10 U	0.98 U
2,4-Dinitrotoluene	--	--	--	mg/kg		2.1 U	0.2 U
2,6-Dinitrotoluene	--	--	--	mg/kg		2.1 U	0.2 U
2-Chloronaphthalene	--	--	--	mg/kg		2.1 U	0.2 U
2-Chlorophenol	--	--	--	mg/kg		2.1 U	0.2 U
2-Methylnaphthalene	--	--	--	mg/kg		2.5 U	0.25 U
2-Methylphenol	0.33	100	0.33	mg/kg		2.1 U	0.2 U
2-Nitroaniline	--	--	--	mg/kg		2.1 U	0.2 U
2-Nitrophenol	--	--	--	mg/kg		4.5 U	0.44 U
3&4-Methylphenol	0.33	100	0.33	mg/kg		3 U	0.3 U
3,3'-Dichlorobenzidine	--	--	--	mg/kg		2.1 U	0.2 U
3-Nitroaniline	--	--	--	mg/kg		2.1 U	0.2 U
4,6-Dinitro-2-methylphenol	--	--	--	mg/kg		5.4 U	0.53 U
4-Bromophenyl phenyl ether	--	--	--	mg/kg		2.1 U	0.2 U
4-Chloro-3-methylphenol	--	--	--	mg/kg		2.1 U	0.2 U
4-Chloroaniline	--	--	--	mg/kg		2.1 U	0.2 U
4-Chlorophenyl phenyl ether	--	--	--	mg/kg		2.1 U	0.2 U
4-Methylphenol	0.33	100	0.33	mg/kg		NA	NA
4-Nitroaniline	--	--	--	mg/kg		2.1 U	0.2 U
4-Nitrophenol	--	--	--	mg/kg		2.9 U	0.29 U
Acenaphthene	20	100	98	mg/kg		1.6 U	0.049 J
Acenaphthylene	100	100	107	mg/kg		0.62 J	0.16 U
Acetophenone	--	--	--	mg/kg		2.1 U	0.2 U
Anthracene	100	100	1000	mg/kg		0.45 J	0.062 J

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-8	SB-8
					Sample Date:	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	10 - 12
Atrazine	--	--	--	mg/kg		NA	NA
Benzaldehyde	--	--	--	mg/kg		NA	NA
Benzo[a]anthracene	**1**	1	1	mg/kg		**2.2**	0.31
Benzo[a]pyrene	**1**	1	22	mg/kg		**2.1**	0.37
Benzo[b]fluoranthene	**1**	1	1.7	mg/kg		**2.6**	0.16
Benzo[g,h,i]perylene	100	100	1000	mg/kg		1.5 J	0.32
Benzo[k]fluoranthene	**0.8**	3.9	1.7	mg/kg		0.62 J	0.12 U
Benzoic Acid	--	--	--	mg/kg		6.7 U	0.66 U
Benzyl Alcohol	--	--	--	mg/kg		2.1 U	0.2 U
Bis(2-chloro-1-methylethyl)ether	--	--	--	mg/kg		2.5 U	0.25 U
Bis(2-chloroethoxy)methane	--	--	--	mg/kg		2.2 U	0.22 U
Bis(2-chloroethyl) ether	--	--	--	mg/kg		1.9 U	0.18 U
Bis(2-ethylhexyl) phthalate	--	--	--	mg/kg		2.1 U	0.2 U
Butylbenzyl phthalate	--	--	--	mg/kg		2.1 U	0.2 U
Caprolactam	--	--	--	mg/kg		NA	NA
Carbazole	--	--	--	mg/kg		0.28 J	0.2 U
Chrysene	**1**	3.9	1	mg/kg		**2**	0.6
Dibenzo[a,h]anthracene	**0.33**	0.33	1000	mg/kg		0.3 J	0.072 J
Dibenzofuran	7	59	210	mg/kg		2.1 U	0.021 J
Diethyl phthalate	--	--	--	mg/kg		2.1 U	0.2 U
Dimethyl phthalate	--	--	--	mg/kg		2.1 U	0.2 U
Di-n-butyl phthalate	--	--	--	mg/kg		2.1 U	0.2 U
Di-n-octyl phthalate	--	--	--	mg/kg		2.1 U	0.2 U
Fluoranthene	100	100	1000	mg/kg		3.9	0.12
Fluorene	30	100	386	mg/kg		2.1 U	0.11 J
Hexachlorobenzene	0.33	1.2	3.2	mg/kg		1.2 U	0.12 U
Hexachlorobutadiene	--	--	--	mg/kg		2.1 U	0.2 U
Hexachlorocyclopentadiene	--	--	--	mg/kg		5.9 U	0.59 U
Hexachloroethane	--	--	--	mg/kg		1.6 U	0.16 U
Indeno[1,2,3-cd]pyrene	**0.5**	0.5	8.2	mg/kg		**1.5 J**	0.08 J
Isophorone	--	--	--	mg/kg		1.9 U	0.18 U
Naphthalene	12	100	12	mg/kg		1.1 J	0.12 J
Nitrobenzene	--	--	--	mg/kg		1.9 U	0.18 U
n-Nitrosodi-n-propylamine	--	--	--	mg/kg		2.1 U	0.2 U
n-Nitrosodiphenylamine	--	--	--	mg/kg		1.6 U	0.16 U
Pentachlorophenol	0.8	6.7	0.8	mg/kg		1.6 U	0.16 U

Table 2. Summary of Semivolatile Organic Compounds in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-8 2/7/2023 0 - 2	SB-8 2/7/2023 10 - 12
Phenanthrene	100	100	1000	mg/kg		2	0.13
Phenols (Total)	--	--	--	mg/kg		2.1 U	0.2 U
Pyrene	100	100	1000	mg/kg		3.7	0.57

Table 3. Summary of Metals in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	RXSB-1	RXSB-2	RXSB-3	SB-1	SB-1	SB-2	SB-2
					Sample Date:	9/26/2023	9/26/2023	9/26/2023	2/6/2023	2/6/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	0 - 1.5	0 - 2	0 - 2	15 - 17	0 - 2	20 - 22
Aluminum	--	--	--	mg/kg		9300	14100	9500	3870	9680	3000	8590
Antimony	--	--	--	mg/kg		0.95	2.2	0.74 J	0.910 J	4.60 U	0.880 J	0.566 J
Arsenic	**13**	16	16	mg/kg		5	4.5	5.2	10.8	1.92	**23.8**	3.17
Barium	**350**	400	820	mg/kg		103	**391**	95.4	91.4	43.1	43.9	56.8
Beryllium	7.2	72	47	mg/kg		0.46	1.7	0.48	0.227 J	0.468	0.185 J	0.51
Cadmium	2.5	4.3	7.5	mg/kg		0.25 J	1.5	0.26 J	0.838	0.920 U	0.762 J	0.937 U
Calcium	--	--	--	mg/kg		8570	41200	9980	46500	684	56500	832
Chromium	30	180	--	mg/kg		19.8	21.7	20.8	11.6	18.5	7.19	16.4
Cobalt	--	--	--	mg/kg		6.9	86.8	12.8	3.58	8.1	2.36	7.36
Copper	**50**	270	1720	mg/kg		30.5	**50.3**	24.3	18.4	16.2	13	17.6
Iron	--	--	--	mg/kg		16100	13800	14500	9190	12800	5320	13400
Lead	**63**	400	450	mg/kg		**186**	**733**	**196**	**417**	7.54	**820**	19.2
Magnesium	--	--	--	mg/kg		3400	14900	3150	2860	3290	1350	2630
Manganese	1600	2000	2000	mg/kg		273	494	276	211	214	169	137
Mercury	**0.18**	0.81	0.73	mg/kg		**0.44**	**1.2**	**0.55**	**0.464**	0.079 U	**2.65**	0.084 U
Nickel	**30**	310	130	mg/kg		**30.3**	25.5	27.9	18.2	**54.8**	7.56	**47.8**
Potassium	--	--	--	mg/kg		1080	1390	1220	608	1000	471	928
Selenium	**3.9**	180	4	mg/kg		0.36 J	0.64 J	0.21 J	0.712 J	1.84 U	**11**	1.87 U
Silver	2	180	8.3	mg/kg		0.12 J	1.1	0.14 J	0.414 U	0.465 U	0.430 U	0.460 U
Sodium	--	--	--	mg/kg		164	581	202	160 J	66.1 J	139 J	50.9 J
Thallium	--	--	--	mg/kg		0.11 J	0.070 J	0.097 J	1.63 U	1.84 U	0.270 J	1.87 U
Vanadium	--	--	--	mg/kg		26.4	45.2	24.3	17.5	28.1	14	24.6
Zinc	**109**	10000	2480	mg/kg		**132**	**304**	**123**	**586**	34.2	**218**	31.1

Table 3. Summary of Metals in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	Sample Designation:	SB-3	SB-3	SB-4	SB-4	SB-5	SB-5	SB-6	SB-6
					Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/6/2023	2/6/2023	2/6/2023	2/6/2023
					Sample Depth (ft bls):	0 - 2	18 - 20	0 - 2	18 - 20	0 - 2	15 - 17	0 - 2	22 - 24
Aluminum	--	--	--	mg/kg		5060	2880	5780	7540	5190	7050	4740	2740
Antimony	--	--	--	mg/kg		0.538 J	4.16 U	1.30 J	0.496 J	1.52 J	4.47 U	0.688 J	4.83 U
Arsenic	**13**	16	16	mg/kg		5.08	1.7	7.53	**21**	7.25	3.49	5.95	1.91
Barium	**350**	400	820	mg/kg		287	22.3	**651**	20.8	333	32.6	245	16.4
Beryllium	7.2	72	47	mg/kg		0.221 J	0.174 J	0.294 J	0.326 J	0.326 J	0.437 J	0.258 J	0.207 J
Cadmium	2.5	4.3	7.5	mg/kg		0.429 J	0.833 U	2.32	0.881 U	0.469 J	0.893 U	0.381 J	0.966 U
Calcium	--	--	--	mg/kg		19200	842	37700	942	16200	1120	36100	833
Chromium	30	180	--	mg/kg		10.4	11	22.4	10.2	14.1	8.57	9.23	5.85
Cobalt	--	--	--	mg/kg		3.93	3.72	4.64	7.41	4.77	3.67	3.57	2.66
Copper	**50**	270	1720	mg/kg		19.8	9.25	**73**	20.1	47.1	5.84	21.6	6.53
Iron	--	--	--	mg/kg		9090	7600	12900	15300	14000	9680	10000	6330
Lead	**63**	400	450	mg/kg		**355**	3.74 J	**2200**	8.44	**416**	13.2	**334**	3.04 J
Magnesium	--	--	--	mg/kg		3410	2080	3840	2400	2140	1340	2400	889
Manganese	1600	2000	2000	mg/kg		223	178	222	202	192	164	192	81.3
Mercury	**0.18**	0.81	0.73	mg/kg		**0.34**	0.070 U	**1.62**	0.076 U	**0.782**	0.087 U	**0.247**	0.088 U
Nickel	**30**	310	130	mg/kg		14.6	28.2	19.6	15.5	**41.1**	9.64	12.3	15.8
Potassium	--	--	--	mg/kg		864	559	606	540	530	317	690	240 J
Selenium	**3.9**	180	4	mg/kg		1.63 U	1.66 U	0.309 J	1.76 U	0.440 J	1.79 U	1.73 U	1.93 U
Silver	2	180	8.3	mg/kg		0.410 U	0.411 U	0.430 J	0.431 U	0.497 U	0.439 U	0.426 U	0.483 U
Sodium	--	--	--	mg/kg		292	58.1 J	194	64.8 J	107 J	35.5 J	358	40.7 J
Thallium	--	--	--	mg/kg		1.63 U	1.66 U	1.75 U	1.76 U	1.92 U	1.79 U	1.73 U	1.93 U
Vanadium	--	--	--	mg/kg		17.9	10.2	41.5	35.5	16.4	13.2	16.6	11.7
Zinc	**109**	10000	2480	mg/kg		**230**	18.3	**754**	30.3	**252**	19.1	**218**	13.3

Table 3. Summary of Metals in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-7	SB-7	SB-8	SB-8
					Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	12 - 14	6 - 8	0 - 2	10 - 12
Aluminum	--	--	--	mg/kg		6840	7280	6090	6340
Antimony	--	--	--	mg/kg		0.563 J	3.19 J	0.524 J	4.88 U
Arsenic	**13**	16	16	mg/kg		10.7	**40**	6.25	2.23
Barium	**350**	400	820	mg/kg		253	85.1	192	175
Beryllium	7.2	72	47	mg/kg		0.335 J	0.389 J	0.052 J	0.367 J
Cadmium	2.5	4.3	7.5	mg/kg		0.118 J	0.859 U	0.154 J	0.977 U
Calcium	--	--	--	mg/kg		20100	1800	67800	8500
Chromium	30	180	--	mg/kg		12.7	15	11.4	9.05
Cobalt	--	--	--	mg/kg		5.29	7.23	3.84	3.37
Copper	**50**	270	1720	mg/kg		24.6	43.1	25	8.47
Iron	--	--	--	mg/kg		11600	29100	9250	8270
Lead	**63**	400	450	mg/kg		**203**	**264**	**67.8**	33.8
Magnesium	--	--	--	mg/kg		3550	2130	24600	1640
Manganese	1600	2000	2000	mg/kg		170	174	305	131
Mercury	**0.18**	0.81	0.73	mg/kg		**0.241**	**4.37**	0.131	0.146
Nickel	**30**	310	130	mg/kg		22.6	25.3	12.7	9.5
Potassium	--	--	--	mg/kg		874	710	684	522
Selenium	**3.9**	180	4	mg/kg		1.69 U	1.72 U	2.01 U	1.95 U
Silver	2	180	8.3	mg/kg		0.428 U	0.421 U	0.495 U	0.487 U
Sodium	--	--	--	mg/kg		249	106 J	860	203
Thallium	--	--	--	mg/kg		1.69 U	1.72 U	2.01 U	1.95 U
Vanadium	--	--	--	mg/kg		64.9	24.6	27.4	16.5
Zinc	**109**	10000	2480	mg/kg		**110**	71.9	101	72.8

Table 4. Summary of Polychlorinated Biphenyls in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:**	SB-1	SB-1	SB-2	SB-2	SB-3	SB-3	SB-4
					Sample Date:	2/6/2023	2/6/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023
					Sample Depth (ft bls):	0 - 2	15 - 17	0 - 2	20 - 22	0 - 2	18 - 20	0 - 2
Aroclor-1016	--	--	--	mg/kg		0.0346 U	0.0388 U	0.0365 U	0.0387 U	0.0338 U	0.0346 U	0.0372 U
Aroclor-1221	--	--	--	mg/kg		0.0346 U	0.0388 U	0.0365 U	0.0387 U	0.0338 U	0.0346 U	0.0372 U
Aroclor-1232	--	--	--	mg/kg		0.0346 U	0.0388 U	0.0365 U	0.0387 U	0.0338 U	0.0346 U	0.0372 U
Aroclor-1242	--	--	--	mg/kg		0.0346 U	0.0388 U	0.0365 U	0.0387 U	0.0338 U	0.0346 U	0.0372 U
Aroclor-1248	--	--	--	mg/kg		0.0346 U	0.0388 U	0.0365 U	0.0387 U	0.0338 U	0.0346 U	0.0372 U
Aroclor-1254	--	--	--	mg/kg		0.0346 U	0.0302 J	0.0365 U	0.0387 U	0.096	0.0346 U	0.0372 U
Aroclor-1260	--	--	--	mg/kg		0.0346 U	0.0388 U	0.0365 U	0.0387 U	0.0343	0.0346 U	0.149
Aroclor-1262	--	--	--	mg/kg		0.0346 U	0.0388 U	0.0365 U	0.0387 U	0.0338 U	0.0346 U	0.0372 U
Aroclor-1268	--	--	--	mg/kg		0.00878 J	0.00912 J	0.0365 U	0.0387 U	0.0338 U	0.0346 U	0.0372 U
Aroclor (Total)	**0.1**	1	3.2	mg/kg		0.00878 J	0.0393 J	0.0365 U	0.0387 U	**0.13**	0.0346 U	**0.149**

Table 4. Summary of Polychlorinated Biphenyls in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-4 2/7/2023 18 - 20	SB-5 2/6/2023 0 - 2	SB-5 2/6/2023 15 - 17	SB-6 2/6/2023 0 - 2	SB-6 2/6/2023 22 - 24	SB-7 2/7/2023 12 - 14	SB-7 2/7/2023 6 - 8
Aroclor-1016	--	--	--	mg/kg		0.0363 U	0.0408 U	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor-1221	--	--	--	mg/kg		0.0363 U	0.0408 U	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor-1232	--	--	--	mg/kg		0.0363 U	0.0408 U	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor-1242	--	--	--	mg/kg		0.0363 U	0.0408 U	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor-1248	--	--	--	mg/kg		0.0363 U	0.0408 U	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor-1254	--	--	--	mg/kg		0.0363 U	0.0408 U	0.225	0.0356 U	0.0403 U	0.0281 J	0.0129 J
Aroclor-1260	--	--	--	mg/kg		0.0363 U	0.0408 U	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor-1262	--	--	--	mg/kg		0.0363 U	0.0408 U	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor-1268	--	--	--	mg/kg		0.0363 U	0.00809 J	0.0371 U	0.0356 U	0.0403 U	0.0355 U	0.0363 U
Aroclor (Total)	**0.1**	1	3.2	mg/kg		0.0363 U	0.00809 J	**0.225**	0.0356 U	0.0403 U	0.0281 J	0.0129 J

Table 4. Summary of Polychlorinated Biphenyls in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-8 2/7/2023 0 - 2	SB-8 2/7/2023 10 - 12
Aroclor-1016	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor-1221	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor-1232	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor-1242	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor-1248	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor-1254	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor-1260	--	--	--	mg/kg		0.0135 J	0.0409 U
Aroclor-1262	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor-1268	--	--	--	mg/kg		0.0426 U	0.0409 U
Aroclor (Total)	**0.1**	1	3.2	mg/kg		0.0135 J	0.0409 U

Table 5. Summary of Per- and Polyfluoroalkyl Substances in Soil, 280 Bergen Street, Brooklyn, New York

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Restricted Residential SCO	NYSDEC Part 375 Protection of Groundwater SCO	Units	**Sample Designation:** **Sample Date:** **Sample Depth (ft bls):**	SB-2 2/7/2023 20 - 22
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	--	--	--	ng/g		0.787 U
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	--	--	--	ng/g		0.787 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NETFOSAA)	--	--	--	ng/g		0.197 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMEFOSAA)	--	--	--	ng/g		0.197 U
Perfluorobutanesulfonic Acid (PFBS)	--	--	--	ng/g		0.197 U
Perfluorobutanoic Acid (PFBA)	--	--	--	ng/g		0.787 U
Perfluorodecanesulfonic Acid (PFDS)	--	--	--	ng/g		0.197 U
Perfluorodecanoic Acid (PFDA)	--	--	--	ng/g		0.197 U
Perfluorododecanoic Acid (PFDOA)	--	--	--	ng/g		0.197 U
Perfluoroheptanesulfonic Acid (PFHPS)	--	--	--	ng/g		0.197 U
Perfluoroheptanoic Acid (PFHPA)	--	--	--	ng/g		0.197 U
Perfluorohexanesulfonic Acid (PFHXS)	--	--	--	ng/g		0.197 U
Perfluorohexanoic Acid (PFHxA)	--	--	--	ng/g		0.197 U
Perfluorononanoic Acid (PFNA)	--	--	--	ng/g		0.197 U
Perfluorooctanesulfonamide (FOSA)	--	--	--	ng/g		0.197 U
Perfluorooctanesulfonic Acid (PFOS)	0.88	44	3.7	ng/g		0.197 U
Perfluorooctanoic Acid (PFOA)	0.66	33	1.1	ng/g		0.197 U
Perfluoropentanoic Acid (PFPEA)	--	--	--	ng/g		0.394 U
Perfluorotetradecanoic Acid (PFTA)	--	--	--	ng/g		0.197 U
Perfluorotridecanoic Acid (PFTRDA)	--	--	--	ng/g		0.197 U
Perfluoroundecanoic Acid (PFUNA)	--	--	--	ng/g		0.197 U
PFOA/PFOS, Total	--	--	--	ng/g		0.197 U

Table 6. Summary of Volatile Organic Compounds in Groundwater, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:**	MW-1	MW-2	MW-3	MW-4
		Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023
1,1,1,2-Tetrachloroethane	5		2.5 U	2.5 U	2.5 U	2.5 U
1,1,1-Trichloroethane	5		2.5 U	2.5 U	2.5 U	2.5 U
1,1,2,2-Tetrachloroethane	5		0.50 U	0.50 U	0.50 U	0.50 U
1,1,2-Trichloroethane	1		1.5 U	1.5 U	1.5 U	1.5 U
1,1-Dichloroethane	5		2.5 U	2.5 U	2.5 U	2.5 U
1,1-Dichloroethene	5		0.50 U	0.50 U	0.50 U	0.50 U
1,1-Dichloropropene	5		2.5 U	2.5 U	2.5 U	2.5 U
1,2,3-Trichlorobenzene	5		2.5 U	2.5 U	2.5 U	2.5 U
1,2,3-Trichloropropane	0.04		2.5 U	2.5 U	2.5 U	2.5 U
1,2,4,5-Tetramethylbenzene	**5**		**78**	**18**	0.64 J	2.0 U
1,2,4-Trichlorobenzene	5		2.5 U	2.5 U	2.5 U	2.5 U
1,2,4-Trimethylbenzene	**5**		0.81 J	**54**	2.5 U	2.5 U
1,2-Dibromoethane	0.0006		2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichlorobenzene	3		2.5 U	2.5 U	2.5 U	2.5 U
1,2-Dichloroethane	0.6		0.50 U	0.50 U	0.50 U	0.50 U
1,2-Dichloroethene (total)	5		2.5 U	2.5 U	2.5 U	2.5 U
1,2-Dichloropropane	1		1.0 U	1.0 U	1.0 U	1.0 U
1,3,5-Trimethylbenzene	**5**		2.5 U	**12**	2.5 U	2.5 U
1,3-Dichlorobenzene	3		2.5 U	2.5 U	2.5 U	2.5 U
1,3-Dichloropropane	5		2.5 U	2.5 U	2.5 U	2.5 U
1,3-Dichloropropene	0.4		0.50 U	0.50 U	0.50 U	0.50 U
1,4-Dichlorobenzene	3		2.5 U	2.5 U	2.5 U	2.5 U
1,4-Diethylbenzene	--		21	3.8	2.0 U	2.0 U
1,4-Dioxane	--		250 U	250 U	250 U	250 U
2,2-Dichloropropane	5		2.5 U	2.5 U	2.5 U	2.5 U
2-Butanone (MEK)	50		5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	50		5.0 U	5.0 U	5.0 U	5.0 U
4-Ethyltoluene	--		2.0 U	12	2.0 U	2.0 U
4-Methyl-2-pentanone (MIBK)	--		5.0 U	5.0 U	5.0 U	5.0 U
Acetone	50		11	5.0 U	5.0 U	5.0 U
Acrylonitrile	5		5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1		0.26 J	0.50 U	0.50 U	0.50 U
Bromobenzene	5		2.5 U	2.5 U	2.5 U	2.5 U
Bromochloromethane	5		2.5 U	2.5 U	2.5 U	2.5 U
Bromodichloromethane	50		0.50 U	0.50 U	0.50 U	0.50 U
Bromoform	50		2.0 U	2.0 U	2.0 U	2.0 U
Bromomethane	5		2.5 U	2.5 U	2.5 U	2.5 U
Carbon disulfide	60		5.0 U	5.0 U	5.0 U	5.0 U
Carbon tetrachloride	5		0.50 U	0.50 U	0.50 U	0.50 U

Table 6. Summary of Volatile Organic Compounds in Groundwater, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:**	MW-1	MW-2	MW-3	MW-4
		Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023
Chlorobenzene	5		2.5 U	2.5 U	2.5 U	2.5 U
Chloroethane	5		2.5 U	2.5 U	2.5 U	2.5 U
Chloroform	7		2.5 U	2.5 U	2.5 U	2.5 U
Chloromethane	5		2.5 U	2.5 U	2.5 U	2.5 U
cis-1,2-Dichloroethene	5		2.5 U	2.5 U	2.5 U	2.5 U
cis-1,3-Dichloropropene	--		0.50 U	0.50 U	0.50 U	0.50 U
Dibromochloromethane	50		0.50 U	0.50 U	0.50 U	0.50 U
Dibromochloropropane	0.04		2.5 U	2.5 U	2.5 U	2.5 U
Dibromomethane	5		5.0 U	5.0 U	5.0 U	5.0 U
Dichlorodifluoromethane	5		5.0 U	5.0 U	5.0 U	5.0 U
Diethyl Ether	--		2.5 U	2.5 U	2.5 U	2.5 U
Ethylbenzene	5		1.1 J	1.4 J	2.5 U	2.5 U
Hexachlorobutadiene	0.5		2.5 U	2.5 U	2.5 U	2.5 U
Isopropylbenzene	**5**		**30**	4.5	2.5 U	2.5 U
m+p-Xylene	**5**		2.5 U	**7.1**	2.5 U	2.5 U
Methylene chloride	5		2.5 U	2.5 U	2.5 U	2.5 U
MTBE	10		2.5 U	2.5 U	2.5 U	2.5 U
Naphthalene	**10**		7.1	**38**	1.6 J	2.5 U
n-Butylbenzene	**5**		**27**	3.6	2.5 U	2.5 U
n-Propylbenzene	**5**		**64**	3.7	2.5 U	2.5 U
o-Chlorotoluene	5		2.5 U	2.5 U	2.5 U	2.5 U
o-Xylene	5		0.71 J	4.5	2.5 U	2.5 U
p-Chlorotoluene	5		2.5 U	2.5 U	2.5 U	2.5 U
p-Isopropyltoluene	5		2.5 U	2.8	2.5 U	2.5 U
sec-Butylbenzene	**5**		**23**	**8**	2.5 U	2.5 U
Styrene	5		2.5 U	2.5 U	2.5 U	2.5 U
tert-Butylbenzene	5		1.0 J	2.5 U	2.5 U	2.5 U
Tetrachloroethene	5		0.50 U	0.50 U	0.23 J	0.50 U
Toluene	5		2.5 U	2.5 U	2.5 U	2.5 U
trans-1,2-Dichloroethene	5		2.5 U	2.5 U	2.5 U	2.5 U
trans-1,3-Dichloropropene	--		0.50 U	0.50 U	0.50 U	0.50 U
trans-1,4-Dichloro-2-butene	5		2.5 U	2.5 U	2.5 U	2.5 U
Trichloroethene	5		0.50 U	0.50 U	1.1	0.50 U
Trichlorofluoromethane	5		2.5 U	2.5 U	2.5 U	2.5 U
Vinyl acetate	--		5.0 U	5.0 U	5.0 U	5.0 U
Vinyl chloride	2		1.0 U	1.0 U	1.0 U	1.0 U
Xylenes (total)	**5**		0.71 J	**12**	2.5 U	2.5 U

Table 7. Summary of Semivolatile Organic Compounds in Groundwater, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:** **Sample Date:**	MW-1 2/7/2023	MW-2 2/7/2023	MW-3 2/7/2023	MW-4 2/7/2023
1,1'-Biphenyl	**5**		2.6 U	**11**	2.0 U	2.0 U
1,2,4,5-Tetrachlorobenzene	5		13 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	5		6.6 U	5.0 U	5.0 U	5.0 U
1,2-Dichlorobenzene	3		2.6 U	2.0 U	2.0 U	2.0 U
1,3-Dichlorobenzene	3		2.6 U	2.0 U	2.0 U	2.0 U
1,4-Dichlorobenzene	3		2.6 U	2.0 U	2.0 U	2.0 U
1,4-Dioxane	0.35		NA	144 U	NA	NA
2,4,5-Trichlorophenol	--		6.6 U	5.0 U	5.0 U	5.0 U
2,4,6-Trichlorophenol	--		6.6 U	5.0 U	5.0 U	5.0 U
2,4-Dichlorophenol	5		6.6 U	5.0 U	5.0 U	5.0 U
2,4-Dimethylphenol	50		6.6 U	5.0 U	5.0 U	5.0 U
2,4-Dinitrophenol	10		26 U	20 U	20 U	20 U
2,4-Dinitrotoluene	5		6.6 U	5.0 U	5.0 U	5.0 U
2,6-Dinitrotoluene	5		6.6 U	5.0 U	5.0 U	5.0 U
2-Chloronaphthalene	10		0.25 U	0.20 U	0.20 U	0.20 U
2-Chlorophenol	--		2.6 U	2.0 U	2.0 U	2.0 U
2-Methylnaphthalene	--		880	40	3.6	0.4
2-Methylphenol	--		6.6 U	5.0 U	5.0 U	5.0 U
2-Nitroaniline	5		6.6 U	5.0 U	5.0 U	5.0 U
2-Nitrophenol	--		13 U	10 U	10 U	10 U
3&4-Methylphenol	--		6.6 U	5.0 U	5.0 U	5.0 U
3,3'-Dichlorobenzidine	5		6.6 U	5.0 U	5.0 U	5.0 U
3-Nitroaniline	5		6.6 U	5.0 U	5.0 U	5.0 U
4,6-Dinitro-2-methylphenol	--		13 U	10 U	10 U	10 U
4-Bromophenyl phenyl ether	--		2.6 U	2.0 U	2.0 U	2.0 U
4-Chloro-3-methylphenol	--		2.6 U	2.0 U	2.0 U	2.0 U
4-Chloroaniline	5		6.6 U	5.0 U	5.0 U	5.0 U
4-Chlorophenyl phenyl ether	--		2.6 U	2.0 U	2.0 U	2.0 U
4-Nitroaniline	5		6.6 U	5.0 U	5.0 U	5.0 U
4-Nitrophenol	--		13 U	10 U	10 U	10 U
Acenaphthene	20		0.12 U	4.1	0.66	0.21
Acenaphthylene	20		14	0.84	0.4	0.17
Acetophenone	--		6.6 U	5.0 U	5.0 U	5.0 U
Anthracene	50		0.12 U	0.10 U	0.58	0.37
Benzo[a]anthracene	**0.002**		**8.7**	**0.23**	**1.3**	**1**
Benzo[a]pyrene	**0**		**7.1**	**0.2**	**1.2**	**1**
Benzo[b]fluoranthene	**0.002**		**8.3**	**0.24**	**1.5**	**1.3**

Table 7. Summary of Semivolatile Organic Compounds in Groundwater, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:**	MW-1	MW-2	MW-3	MW-4
		Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023
Benzo[g,h,i]perylene	--		4.1	0.14	0.78	0.63
Benzo[k]fluoranthene	**0.002**		**2.5**	**0.08 J**	**0.42**	**0.44**
Benzoic Acid	--		66 U	50 U	50 U	50 U
Benzyl Alcohol	--		2.6 U	2.0 U	2.0 U	2.0 U
Bis(2-chloro-1-methylethyl)ether	5		2.6 U	2.0 U	2.0 U	2.0 U
Bis(2-chloroethoxy)methane	5		6.6 U	5.0 U	5.0 U	5.0 U
Bis(2-chloroethyl) ether	--		2.6 U	2.0 U	2.0 U	2.0 U
Bis(2-ethylhexyl) phthalate	**5**		**7.8**	3.0 U	3.0 U	3.0 U
Butylbenzyl phthalate	50		6.6 U	5.0 U	5.0 U	5.0 U
Carbazole	--		2.6 U	1.4 J	2.0 U	2.0 U
Chrysene	**0.002**		**8.5**	**0.22**	**1.2**	**0.99**
Dibenzo[a,h]anthracene	--		1	0.03 J	0.19	0.16
Dibenzofuran	--		21	2.6	2.0 U	2.0 U
Diethyl phthalate	50		6.6 U	5.0 U	5.0 U	5.0 U
Dimethyl phthalate	50		6.6 U	5.0 U	5.0 U	5.0 U
Di-n-butyl phthalate	50		6.6 U	5.0 U	1.3 J	5.0 U
Di-n-octyl phthalate	--		6.6 U	5.0 U	5.0 U	5.0 U
Fluoranthene	50		24	0.62	2.9	2.4
Fluorene	**50**		**57**	5.1	0.97	0.23
Hexachlorobenzene	0.04		1.0 U	0.80 U	0.80 U	0.80 U
Hexachlorobutadiene	0.5		0.62 U	0.50 U	0.50 U	0.50 U
Hexachlorocyclopentadiene	5		26 U	20 U	20 U	20 U
Hexachloroethane	5		1.0 U	0.80 U	0.80 U	0.80 U
Indeno[1,2,3-cd]pyrene	**0.002**		**4.5**	**0.14**	**0.86**	**0.74**
Isophorone	50		6.6 U	5.0 U	5.0 U	5.0 U
Naphthalene	**10**		5.9	**13**	0.68	0.37
Nitrobenzene	0.4		2.6 U	2.0 U	2.0 U	2.0 U
n-Nitrosodi-n-propylamine	--		6.6 U	5.0 U	5.0 U	5.0 U
n-Nitrosodiphenylamine	50		2.6 U	2.0 U	2.0 U	2.0 U
Pentachlorophenol	1		1.0 U	0.80 U	0.80 U	0.80 U
Phenanthrene	**50**		**290**	7	3.4	1.7
Phenols (Total)	1		6.6 U	5.0 U	5.0 U	5.0 U
Pyrene	50		38	1	2.8	1.9

Table 8. Summary of Total and Dissolved Metals in Groundwater, 280 Bergen Street, Brooklyn, New York

	NYSDEC	**Sample Designation:**	MW-1	MW-1	MW-2	MW-2	MW-3	MW-3	MW-4	MW-4
Parameter	AWQSGVs	**Sample Date:**	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023	2/7/2023
(Concentrations in µg/L)	(µg/L)		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
Aluminum	--		21.7	53000	11.6	12400	12.4	10100	56.5	33800
Antimony	3		0.96 J	40 U	4 U	4 U	0.48 J	4 U	4 U	4 U
Arsenic	**25**		3.59	**83.32**	6.46	**48.29**	0.42 J	8.92	11.5	**54.92**
Barium	**1000**		92.01	**2912**	198.8	613.5	38.88	322	66.81	**1339**
Beryllium	**3**		0.5 U	**23.58**	0.5 U	1.67	0.5 U	0.89	0.5 U	**6.11**
Cadmium	5		0.2 U	3.53	0.2 U	1.17	0.2 U	0.67	0.2 U	3.17
Calcium	--		59700	185000	112000	230000	47000	54200	86800	176000
Chromium	**50**		1 U	**577.1**	1 U	39.99	0.18 J	34.41	0.22 J	**73.94**
Cobalt	--		1.03	199	2.27	23.15	0.74	22.26	4.57	110
Copper	**200**		0.44 J	**235.8**	0.47 J	88.56	0.56 J	51.13	1 U	172.2
Iron	**300**		53.6	**332000**	39.5 J	**41000**	50 U	**20500**	116	**81200**
Lead	**25**		0.53 J	**598**	0.37 J	**1702**	1.16	**228.7**	0.37 J	**906.9**
Magnesium	35000		3880	23200	16000	21400	8040	17200	12800	28700
Manganese	**300**		**948.6**	**12220**	**1446**	**2067**	**366.4**	**1743**	**5033**	**12500**
Mercury	**0.7**		0.2 U	0.26	0.2 U	**0.87**	0.2 U	0.34	0.2 U	0.2
Nickel	**100**		8.49	**677.3**	5.44	92.07	17.41	**183.2**	7.37	**240.7**
Potassium	--		7970	18800	20700	23000	6240	8230	5860	12600
Selenium	**10**		5 U	**305**	3.18 J	**31.7**	5 U	**14.3**	5 U	**69.7**
Silver	50		0.4 U	4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Sodium	**20000**		**27200**	**21800**	9000	11800	**200000**	**198000**	**37500**	**36900**
Thallium	**0.5**		0.14 J	20 U	1 U	**0.57 J**	1 U	0.3 J	1 U	**0.53 J**
Vanadium	--		5 U	750.3	5 U	78.93	5 U	31.4	5 U	181.2
Zinc	2000		10 U	951.4	10 U	257.4	10 U	164.6	6.99 J	878.9

Table 9. Summary of Polychlorinated Biphenyls in Groundwater, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in µg/L)	NYSDEC AWQSGVs (µg/L)	**Sample Designation:**	MW-1	MW-2	MW-3	MW-4
		Sample Date:	2/7/2023	2/7/2023	2/7/2023	2/7/2023
Aroclor-1016	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1221	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1232	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1242	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1248	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1254	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1260	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1262	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor-1268	--		0.071 U	0.071 U	0.071 U	0.071 U
Aroclor (Total)	0.09		0.071 U	0.071 U	0.071 U	0.071 U

Table 10. Summary of Per- and Polyfluoroalkyl Substances in Groundwater, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in ng/L)	NYSDEC AWQSGVs (ng/L)	**Sample Designation:**	MW-2
		Sample Date:	2/7/2023
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	--		5.95 U
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	--		5.95 U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NETFOSAA)	--		1.49 U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMEFOSAA)	--		1.49 U
Perfluorobutanesulfonic Acid (PFBS)	--		1.49 U
Perfluorobutanoic Acid (PFBA)	--		1.71 J
Perfluorodecanesulfonic Acid (PFDS)	--		1.49 U
Perfluorodecanoic Acid (PFDA)	--		1.49 U
Perfluorododecanoic Acid (PFDOA)	--		1.49 U
Perfluoroheptanesulfonic Acid (PFHPS)	--		1.49 U
Perfluoroheptanoic Acid (PFHPA)	--		3.2
Perfluorohexanesulfonic Acid (PFHXS)	--		0.595 J
Perfluorohexanoic Acid (PFHxA)	--		4.76
Perfluorononanoic Acid (PFNA)	--		1.34 JF
Perfluorooctanesulfonamide (FOSA)	--		1.49 U
Perfluorooctanesulfonic Acid (PFOS)	**2.7**		**5.06 F**
Perfluorooctanoic Acid (PFOA)	**6.7**		**13**
Perfluoropentanoic Acid (PFPEA)	--		5.43
Perfluorotetradecanoic Acid (PFTA)	--		1.49 U
Perfluorotridecanoic Acid (PFTRDA)	--		1.49 U
Perfluoroundecanoic Acid (PFUNA)	--		1.49 U
PFOA/PFOS, Total	--		18.1

Table 11. Summary of Volatile Organic Compounds in Sub-Slab Vapor and Soil Vapor, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in ug/m^3)	**Sample Designation:** **Sample Date:**	SS-1 2/6/2023	SS-2 2/6/2023	SS-3 2/6/2023	SS-7 2/6/2023	SS-8 2/6/2023	SV-1 2/6/2023	SV-6 2/6/2023	SV-7 2/6/2023
1,1,1-Trichloroethane		1.09 U	**26.3**	**22.8**	1.09 U	1.09 U	5.46 U	**18**	**64.4**
1,1,2,2-Tetrachloroethane		1.37 U	1.37 U	1.37 U	1.37 U	1.37 U	6.87 U	13.7 U	7.55 U
1,1,2-Trichloroethane		1.09 U	1.09 U	1.09 U	1.09 U	1.09 U	5.46 U	10.9 U	6.00 U
1,1-Dichloroethane		0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	4.05 U	8.09 U	4.45 U
1,1-Dichloroethene		0.793 U	0.793 U	0.793 U	0.793 U	0.793 U	3.96 U	7.93 U	4.36 U
1,2,4-Trichlorobenzene		1.48 U	1.48 U	1.48 U	1.48 U	1.48 U	7.42 U	14.8 U	8.17 U
1,2,4-Trimethylbenzene		**14.6**	**11**	**16.8**	**17.2**	**17.2**	**8.41**	9.83 U	**8.36**
1,2-Dibromoethane		1.54 U	1.54 U	1.54 U	1.54 U	1.54 U	7.69 U	15.4 U	8.45 U
1,2-Dichlorobenzene		1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	6.01 U	12.0 U	6.61 U
1,2-Dichloroethane		0.809 U	0.809 U	0.809 U	0.809 U	0.809 U	4.05 U	8.09 U	4.45 U
1,2-Dichloropropane		0.924 U	0.924 U	0.924 U	0.924 U	0.924 U	4.62 U	9.24 U	5.08 U
1,3,5-Trimethylbenzene		**2.94**	**2.8**	**2.34**	**2.48**	**3.39**	4.92 U	9.83 U	5.41 U
1,3-Butadiene		0.442 U	0.442 U	0.442 U	0.442 U	0.442 U	**10.6**	**9.82**	**10.9**
1,3-Dichlorobenzene		1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	6.01 U	12.0 U	6.61 U
1,4-Dichlorobenzene		1.20 U	1.20 U	1.20 U	1.20 U	1.20 U	6.01 U	12.0 U	6.61 U
1,4-Dioxane		0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	3.60 U	7.21 U	3.96 U
2-Butanone (MEK)		**4.98**	**7.4**	**33.9**	**11.8**	**2.25**	**20.8**	**16.3**	**47.8**
2-Hexanone		0.820 U	0.820 U	0.820 U	**0.84**	0.820 U	4.10 U	8.20 U	4.51 U
3-Chloropropene		0.626 U	0.626 U	0.626 U	0.626 U	0.626 U	3.13 U	6.26 U	3.44 U
4-Ethyltoluene		**2.36**	**1.54**	**2.27**	**2.04**	**2.61**	4.92 U	9.83 U	5.41 U
4-Methyl-2-pentanone (MIBK)		2.05 U	**11**	2.05 U	2.05 U	2.05 U	10.2 U	20.5 U	11.3 U
Acetone		**21.4**	**153**	**359**	**47.3**	**9.6**	**216**	**34**	**129**
Benzene		**1.02**	**2.05**	**53.7**	**1.89**	**1.01**	**20.2**	**7.8**	**11.1**
Benzyl chloride		1.04 U	1.04 U	1.04 U	1.04 U	1.04 U	5.18 U	10.4 U	5.70 U
Bromodichloromethane		1.34 U	1.34 U	1.34 U	1.34 U	1.34 U	6.70 U	13.4 U	7.37 U
Bromoethene		0.874 U	0.874 U	0.874 U	0.874 U	0.874 U	4.37 U	8.74 U	4.81 U
Bromoform		2.07 U	2.07 U	2.07 U	2.07 U	2.07 U	10.3 U	20.7 U	11.4 U
Bromomethane		0.777 U	0.777 U	0.777 U	0.777 U	0.777 U	3.88 U	7.77 U	4.27 U
Carbon disulfide		**2.56**	**2.29**	**5.42**	**9.34**	0.623 U	**27.6**	6.23 U	**8.59**
Carbon tetrachloride		1.26 U	1.26 U	1.26 U	1.26 U	1.26 U	6.29 U	12.6 U	6.92 U
Chlorobenzene		0.921 U	0.921 U	0.921 U	0.921 U	0.921 U	4.61 U	9.21 U	5.07 U
Chloroethane		0.528 U	0.528 U	0.528 U	0.528 U	0.528 U	2.64 U	5.28 U	2.90 U
Chloroform		0.977 U	**5.91**	**3.86**	**2.25**	0.977 U	**19.3**	9.77 U	**225**
Chloromethane		0.413 U	0.413 U	**0.966**	0.413 U	0.413 U	2.07 U	4.13 U	2.27 U
cis-1,2-Dichloroethene		0.793 U	0.793 U	0.793 U	0.793 U	0.793 U	3.96 U	7.93 U	4.36 U
cis-1,3-Dichloropropene		0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	4.54 U	9.08 U	4.99 U
Cyclohexane		0.688 U	0.688 U	**46.5**	0.688 U	0.688 U	3.44 U	6.88 U	**9.02**

Table 11. Summary of Volatile Organic Compounds in Sub-Slab Vapor and Soil Vapor, 280 Bergen Street, Brooklyn, New York

Parameter (Concentrations in ug/m^3)	**Sample Designation:**	SS-1	SS-2	SS-3	SS-7	SS-8	SV-1	SV-6	SV-7
	Sample Date:	2/6/2023	2/6/2023	2/6/2023	2/6/2023	2/6/2023	2/6/2023	2/6/2023	2/6/2023
Dibromochloromethane		1.70 U	1.70 U	1.70 U	1.70 U	1.70 U	8.52 U	17.0 U	9.37 U
Dichlorodifluoromethane		**2.3**	**2.33**	**2.44**	**2.59**	**2.21**	4.94 U	9.89 U	5.44 U
Ethanol		9.42 U	**47.9**	**166**	9.42 U	9.42 U	**130**	94.2 U	51.8 U
Ethyl Acetate		1.80 U	1.80 U	**2.34**	1.80 U	1.80 U	9.01 U	18.0 U	9.91 U
Ethylbenzene		**36.4**	**2.36**	**7.38**	**2.4**	**2.37**	**5.39**	8.69 U	4.78 U
Freon 113		1.53 U	1.53 U	1.53 U	1.53 U	1.53 U	7.66 U	15.3 U	8.43 U
Freon 114		1.40 U	1.40 U	1.40 U	1.40 U	1.40 U	6.99 U	14.0 U	7.69 U
Heptane		**1.16**	**1.91**	**23.4**	**2.62**	**0.926**	**59**	**33.2**	**65.6**
Hexachlorobutadiene		2.13 U	2.13 U	2.13 U	2.13 U	2.13 U	10.7 U	21.3 U	11.7 U
Isooctane		0.934 U	0.934 U	0.934 U	0.934 U	**2.97**	**19.9**	**10**	**11.5**
Isopropanol		**2.61**	**9.91**	**37.4**	**2.11**	**1.24**	**40.8**	12.3 U	**9.05**
m+p-Xylene		**121**	**10.2**	**19.4**	**9.6**	**11.6**	**15.8**	17.4 U	**12.3**
Methylene chloride		**4**	1.74 U	1.74 U	1.74 U	1.74 U	8.69 U	17.4 U	9.55 U
MTBE		0.721 U	0.721 U	0.721 U	0.721 U	0.721 U	3.61 U	7.21 U	3.97 U
n-Hexane		**1.36**	**4.09**	**17.8**	**2.81**	**0.948**	**49.7**	**16**	**35.2**
o-Xylene		**12.1**	**6.21**	**11.5**	**3.83**	**5.43**	**8.17**	8.69 U	**8.43**
Styrene		0.852 U	0.852 U	**3.28**	0.852 U	0.852 U	4.26 U	8.52 U	4.68 U
t-Butyl Alcohol		**4.43**	**3.03**	**4.09**	**20.1**	**2.96**	**9.58**	15.2 U	**10.4**
Tetrachloroethene		**43.3**	**64.4**	**48.2**	**610**	**888**	**58.3**	**59.9**	**59.1**
Tetrahydrofuran		1.47 U	1.47 U	**3.24**	1.47 U	1.47 U	7.37 U	14.7 U	8.11 U
Toluene		**11.2**	**7.61**	**85.5**	**10.1**	**6.03**	**32.3**	**15.6**	**19.9**
trans-1,2-Dichloroethene		0.793 U	0.793 U	0.793 U	0.793 U	0.793 U	3.96 U	7.93 U	4.36 U
trans-1,3-Dichloropropene		0.908 U	0.908 U	0.908 U	0.908 U	0.908 U	4.54 U	9.08 U	4.99 U
Trichloroethene		**1.49**	**33.2**	**8.33**	**3.79**	**1.5**	5.37 U	10.7 U	**138**
Trichlorofluoromethane		**1.63**	**1.87**	**4.98**	**2.05**	**1.4**	5.62 U	11.2 U	6.18 U
Vinyl chloride		0.511 U	0.511 U	0.511 U	0.511 U	0.511 U	2.56 U	5.11 U	2.81 U

Table 12a. Proposed Soil Sampling Locations

Location	Matrix	Sample Intervals	Parameters	Sampling Method	Rationale
Boring depth to the groundwater interface, approximately 18-20 ft bls.					
RXSB-4	Soil	0-2 ft bls; Interval directly below observed fill layer; Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	TCL + 30/TAL	SW-846 8260B;SW-846 8270C;SW-846 8081A; SW-846 8151A;SW-846 8082;SW-846 6010/7471; SW-846 7196A; SW-846 9012B	Evaluate soil conditions above the estimated water table; Evaluate shallow fill conditions; Evaluate conditions below fill layer; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions above groundwater.
RXSB-6					
RXSB-8					
RXSB-10					
RXSB-12					
RXSB-14					
RXSB-7	Soil	Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	TCL + 30/TAL	SW-846 8260B;SW-846 8270C;SW-846 8081A; SW-846 8151A;SW-846 8082;SW-846 6010/7471; SW-846 7196A; SW-846 9012B	Evaluate soil conditions above the estimated water table; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions above groundwater.
RXSB-5					
RXSB-9					
RXSB-11					
RXSB-13					
RXSB-15					
RXSB-4	Soil	0-2 ft bls; Interval directly below observed fill layer; Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	1,4-Dioxane, PFAS	Method 1633 Modified; SW-846 8270D**	Evaluate soil conditions above the estimated water table; Evaluate shallow fill conditions; Evaluate conditions below fill layer; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions above groundwater.
RXSB-6					
RXSB-8					
RXSB-10					
RXSB-12					
RXSB-14					
RXSB-7	Soil	Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	1,4-Dioxane, PFAS	Method 1633 Modified; SW-846 8270D**	Evaluate soil conditions above the estimated water table; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions above groundwater.
RXSB-5					
RXSB-9					
RXSB-11					
RXSB-13					
RXSB-15					

Sample Interval depths are in feet below land surface; Additional intervals may be added based on field observations
**Laboratory will report to their minimum possible standards for each method (QAPP Table 7)
TCL + 30/TAL - includes TCL VOCs + 10 TICs, TCL BNA (SVOCs) + 20 TICs, TCL Pest/Herb/PCBs, TAL Metals
AOC - Area of Concern
TCL - USEPA Contract Laboratory Program Target Compound List
BNA - Base Neutral Acids
TAL - USEPA Contract Laboratory Program Target Analyte List
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls
TICs - Tentatively Identified Compounds
PFAS - Per- and Polyfluoroalkyl Substances
QA/QC samples will be collected as described in the QAPP (Appendix C)
QAPP - Quality Assurance Project Plan

Table 12b. Proposed Groundwater Sampling Locations

Location	Matrix	Sample Interval	Sample Parameters	Sampling Method**	Rationale
RXMW-4	Groundwater	Water Table[1]	TCL + 30/TAL	SW-846 8260B;SW-846 8270C;SW-846 8081A; SW-846 8151A;SW-846 8082;SW-846 6010/7471; SW-846 7196A; SW-846 9012B	To evaluate potential impacts to groundwater quality as a result of historical on-Site and off-Site uses.
RXMW-5					
RXMW-6					
RXMW-7					
RXMW-8					
RXMW-9					
RXMW-10					
RXMW-11					
RXMW-12					
RXMW-4	Groundwater	Water Table[1]	1,4-Dioxane, PFAS	SW-846 8270D; EPA 1633	To evaluate potential emerging contamiannt impacts to groundwater quality as a result of historical on-Site and off-Site uses.
RXMW-5					
RXMW-6					
RXMW-7					
RXMW-8					
RXMW-9					
RXMW-10					
RXMW-11					
RXMW-12					

[1] Groundwater table is estimated to be encountered at 18-30 ft bls

** Laboratory will report to their minimum possible standards for each method (QAPP Table 7)

TCL + 30/TAL - includes TCL VOCs + 10 TICs, TCL BNA (SVOCs) + 20 TICs, TCL Pest/PCBs, TAL Metals, Hexavalent Chromium

TCL - USEPA Contract Laboratory Program Target Compound List

TAL - USEPA Contract Laboratory Program Target Analyte List

VOCs - Volatile Organic Compounds

SVOCs - Semivolatile Organic Compounds

TICs - Tentatively Identified Compounds

PCBs - Polychlorinated Biphenyls

PFAS - Per- and Polyfluoroalkyl Substances

QA/QC samples will be collected as described in the QAPP (Appendix C)

*All groundwater samples will be analyzed for both filtered and unfiltered metals and SVOCs

Table 12c. Proposed Soil Vapor Sampling Locations

Location	Matrix	Sample Depth/Location	Sample Parameters	Sampling Method**	Rationale
RXSV-4	Soil Vapor	Soil vapor points to be installed approximately 5 feet below ground surface.	VOCs	TO-15	To evaluate the nature and extent of soil vapor impacts throughout the Site as a result of on-Site and off-Site historical uses.
RXSV-5					
RXSV-6					
RXSV-7					
RXSV-8					
RXSV-9					

** Laboratory will report to their minimum possible standards for each method (QAPP Table 7)

VOCs - Volatile Organic Compounds

QA/QC samples will be collected as described in the QAPP (Appendix C)

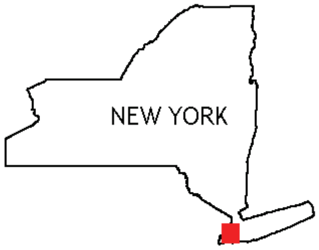
Remedial Investigation Work Plan
Diagravure Film Manufacturing Site

268 Bergen Street, 287 Wyckoff Street and
N/A Wyckoff Street, Brooklyn, New York

NYSDEC Project Number C224403

FIGURES

QUADRANGLE LOCATION



SOURCE:
USGS; 2019, Brooklyn, NY
7.5 Minute Topographic Quadrangle

DRAFT

N

0 2000'

Title:

SITE LOCATION MAP

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 19SEP23	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	1
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y100.02.CDR		

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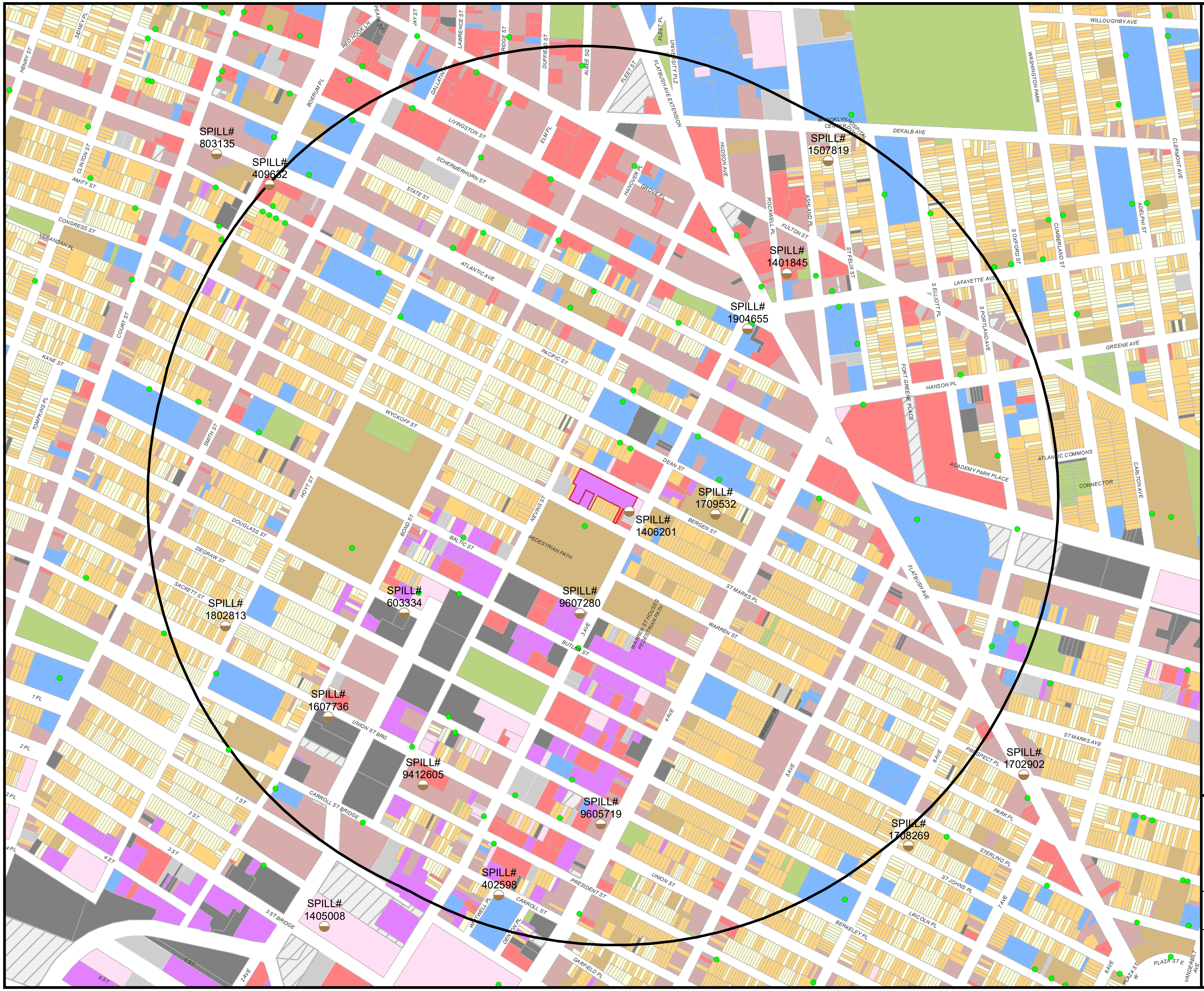

N

LEGEND

- ● PETROLEUM BULK STORAGE SITES
- ◒ NYS OPEN SPILL LOCATION
- ▨ ALL OTHERS OR NO DATA
- ▭ ONE & TWO FAMILY BUILDINGS
- 🟨 MULTI-FAMILY WALK-UP BUILDINGS
- 🟫 MULTI-FAMILY ELEVATOR BUILDINGS
- ▭ MIXED COMMERCIAL & RESIDENTIAL BUILDINGS
- 🟥 COMMERCIAL & OFFICE BUILDINGS
- 🟪 INDUSTRIAL & MANUFACTURING
- ▭ TRANSPORATION & UTILITY
- 🟦 PUBLIC FACILITIES & INSTITUTIONS
- 🟩 OPEN SPACE & OUTDOOR RECREATION
- ▭ PARKING FACILITIES
- ⬛ VACANT LAND
- ▢ 1/2 MILE RADIUS
- ▢ SITE BOUNDARY

NOTES

1. LAND USE, PETROLEUM BULK STORAGE SITES SOURCE: NYC.GOV/PLANNING PLUTO OPEN DATA - FEBRUARY 2024
2. NYS OPEN SPILL SOURCE: NYC SPEED.CITYOFNEWYORK.US

600 0 600'

Title:

SURROUNDING LAND USE

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: J.M.	Date: 04/17/24	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	2
Project Mgr: J.M.	Project: 4442.0001Y000	
File: 4442.0001Y101.2.mxd		

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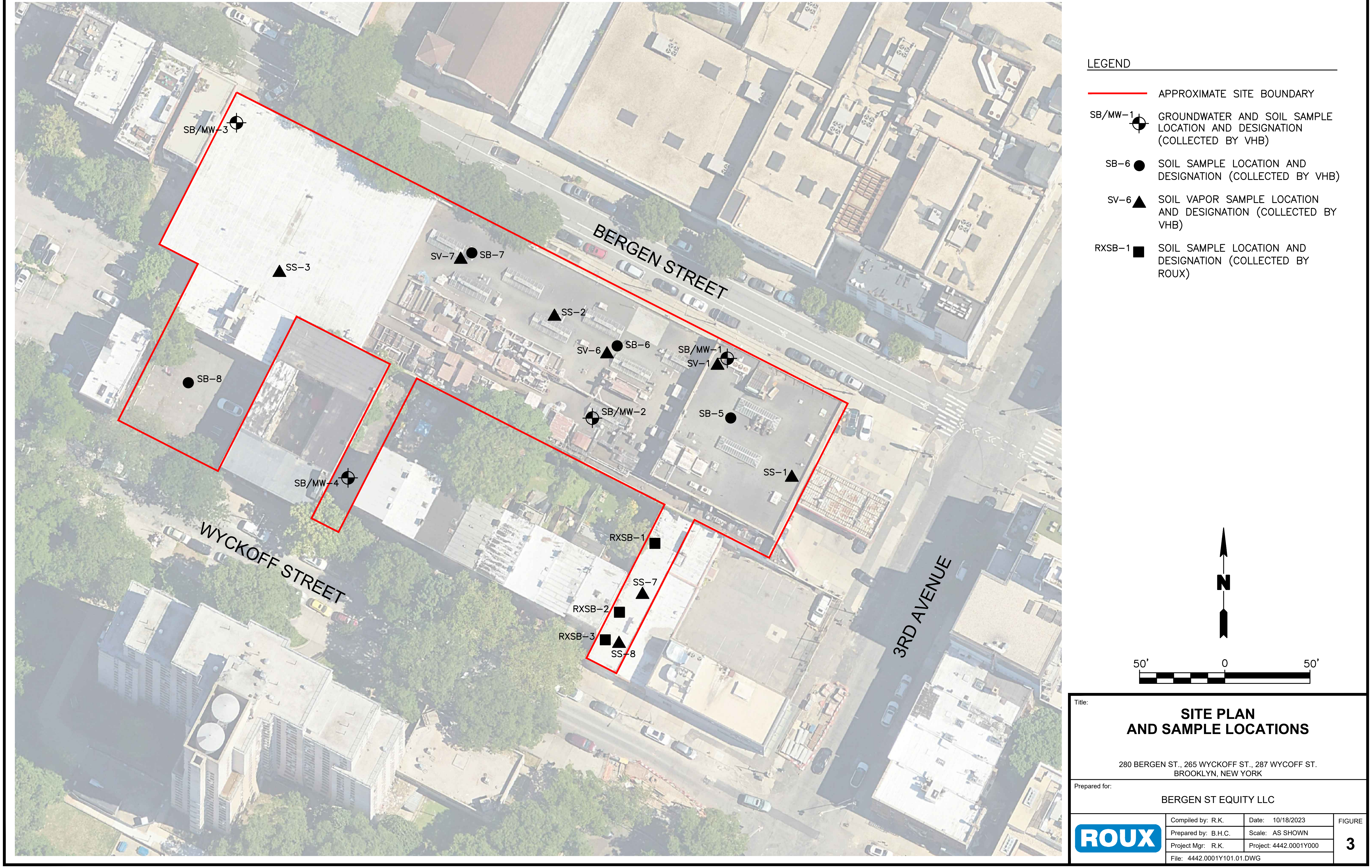

Title:

SITE PLAN
AND SAMPLE LOCATIONS

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 10/18/2023	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	3
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y101.01.DWG		

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SB-3	2/7/23	2/7/23
Depth (ft bls)	0 - 2	18 - 20
SVOCs		
Benzo[a]anthracene	**2**	NE
Benzo[a]pyrene	**1.7**	ND
Benzo[b]fluoranthene	**2.1**	NE
Chrysene	**1.8**	NE
Indeno[1,2,3-cd]pyrene	**1.3**	ND
Metals		
Lead	**355**	NE
Mercury	**0.34**	ND
Zinc	**230**	NE
PCBs		
Total Polychlorinated Biphenyls	**0.13**	ND

SB-7	2/7/23	2/7/23
Depth (ft bls)	6 - 8	12 - 14
Metals		
Arsenic	**40**	NE
Lead	**264**	**203**
Mercury	**4.37**	**0.241**
Zinc	NE	**110**

SB-6	2/6/23	2/6/23
Depth (ft bls)	0 - 2	22 - 24
SVOCs		
Benzo[a]anthracene	**1.2**	ND
Benzo[b]fluoranthene	**1.3**	ND
Chrysene	**1.2**	ND
Indeno[1,2,3-cd]pyrene	**0.71**	ND
Metals		
Lead	**334**	NE
Mercury	**0.247**	ND
Zinc	**218**	NE

SB-1	2/6/23	2/6/23
Depth (ft bls)	0 - 2	15 - 17
SVOCs		
Benzo[a]anthracene	**8.2**	**8.8**
Benzo[a]pyrene	**8**	**8.5**
Benzo[b]fluoranthene	**9.8**	**9.1**
Benzo[k]fluoranthene	**2.1**	**1.8**
Chrysene	**8**	**8.9**
Dibenzo[a,h]anthracene	**0.81**	**1**
Indeno[1,2,3-cd]pyrene	**5.5**	**5.7**
Metals		
Lead	**417**	NE
Mercury	**0.464**	ND
Nickel	NE	**54.8**
Zinc	**586**	NE

SB-5	2/6/23	2/6/23
Depth (ft bls)	0 - 2	15 - 17
SVOCs		
Benzo[a]anthracene	**1.3**	ND
Benzo[a]pyrene	**1.2**	ND
Benzo[b]fluoranthene	**1.5**	ND
Chrysene	**1.3**	ND
Indeno[1,2,3-cd]pyrene	**0.85**	ND
Metals		
Lead	**416**	NE
Mercury	**0.782**	ND
Nickel	**41.1**	NE
Zinc	**252**	NE
PCBs		
Total Polychlorinated Biphenyls	NE	**0.225**

LEGEND

🟥	APPROXIMATE SITE BOUNDARY
SB/MW−1 ⊕	GROUNDWATER AND SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SB−6 ●	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SV−6 ▲	SOIL VAPOR SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
RXSB−1 ■	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY ROUX)

TYPICAL DATA BOX INFORMATION

SAMPLE ID# →

SAMPLE DATE ←

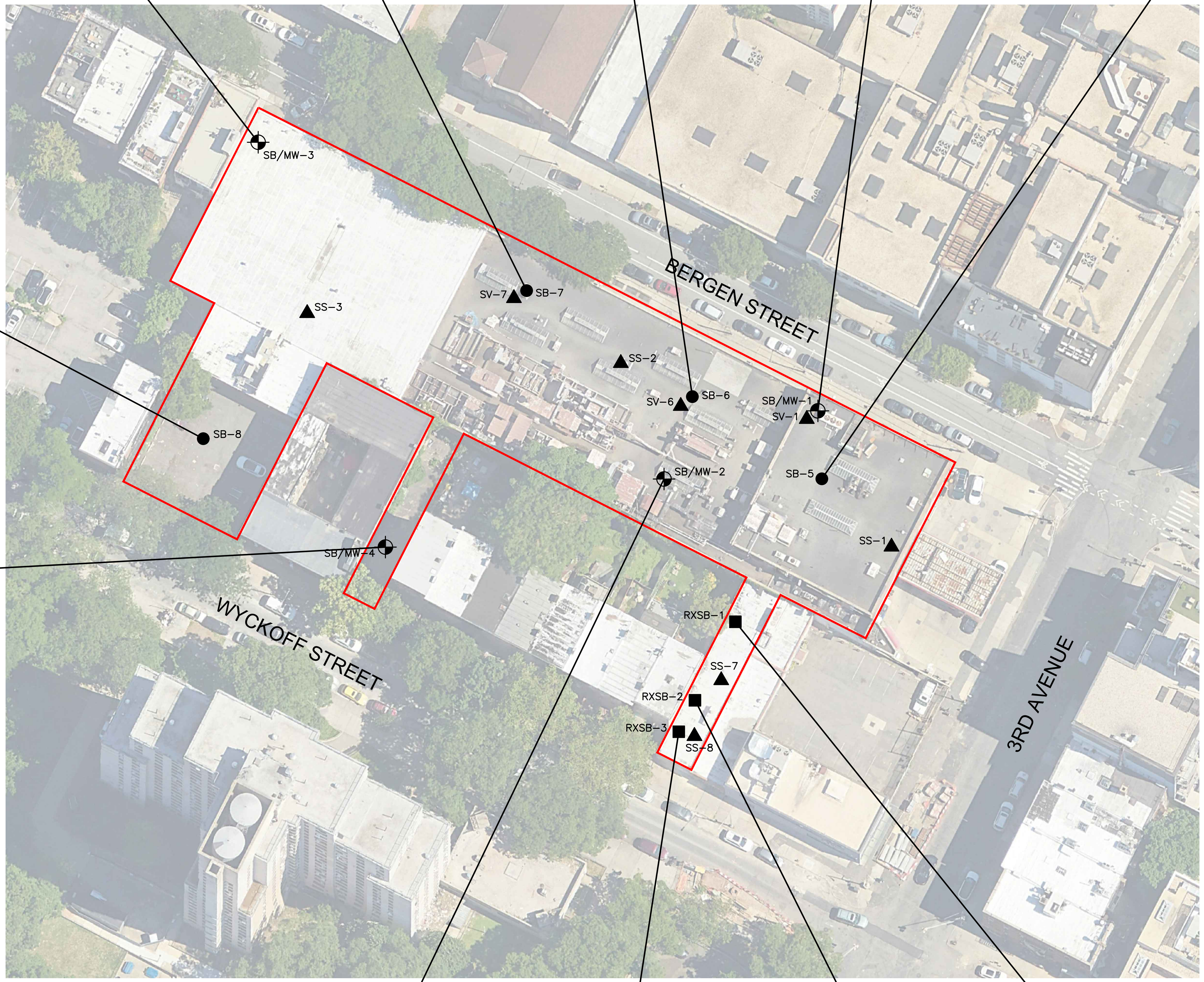
SAMPLE DEPTH ←

ANALYTES

CONCENTRATIONS

SB-7	2/7/23	2/7/23
Depth (ft bls)	6 - 8	12 - 14
Metals		
Arsenic	**40**	NE
Lead	**264**	**203**
Mercury	**4.37**	**0.241**
Zinc	NE	**110**

SB-8	2/7/23	2/7/23
Depth (ft bls)	0 - 2	10 - 12
VOCs		
Acetone	NE	**0.054**
SVOCs		
Benzo[a]anthracene	**2.2**	NE
Benzo[a]pyrene	**2.1**	NE
Benzo[b]fluoranthene	**2.6**	NE
Chrysene	**2**	NE
Indeno[1,2,3-cd]pyrene	**1.5 J**	NE
Metals		
Lead	**67.8**	NE



SB-4	2/7/23	2/7/23
Depth (ft bls)	0 - 2	18 - 20
SVOCs		
Benzo[a]anthracene	**7.2**	ND
Benzo[a]pyrene	**6.9**	ND
Benzo[b]fluoranthene	**8.5**	ND
Benzo[k]fluoranthene	**1.4**	ND
Chrysene	**7.2**	ND
Dibenzo[a,h]anthracene	**0.99**	ND
Indeno[1,2,3-cd]pyrene	**4.9**	ND
Metals		
Arsenic	NE	**21**
Barium	**651**	NE
Copper	**73**	NE
Lead	**2200**	NE
Mercury	**1.62**	ND
Zinc	**754**	NE
PCBs		
Total Polychlorinated Biphenyls	**0.149**	ND

Parameter	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Restricted Residential Soil Cleanup Objectives	NYSDEC Part 375 Protection of Groundwater Soil Cleanup Objectives	Units
VOCs				
1,2,4-Trimethylbenzene	**3.6**	52	3.6	mg/kg
Acetone	**0.05**	100	0.05	mg/kg
Xylenes (total)	**0.26**	100	1.6	mg/kg
SVOCs				
Benzo[a]anthracene	**1**	1	1	mg/kg
Benzo[a]pyrene	**1**	1	22	mg/kg
Benzo[b]fluoranthene	**1**	1	1.7	mg/kg
Benzo[k]fluoranthene	**0.8**	3.9	1.7	mg/kg
Chrysene	**1**	3.9	1	mg/kg
Dibenzo[a,h]anthracene	**0.33**	0.33	1000	mg/kg
Indeno[1,2,3-cd]pyrene	**0.5**	0.5	8.2	mg/kg
Metals				
Arsenic	**13**	16	16	mg/kg
Barium	**350**	400	820	mg/kg
Copper	**50**	270	1720	mg/kg
Lead	**63**	400	450	mg/kg
Mercury	**0.18**	0.81	0.73	mg/kg
Nickel	**30**	310	130	mg/kg
Selenium	**3.9**	180	4	mg/kg
Zinc	**109**	10000	2480	mg/kg
PCBs				
Total Polychlorinated Biphenyls	**0.1**	1	3.2	mg/kg
PFAS	ND	ND	ND	ng/g

mg/kg -Milligrams per kilogram

ng/g -Nanograms per gram

NYSDEC - New York State Department of Environmental Conservation

-- No NYSDEC Part 375 Soil Cleanup Objectives available

J - Estimated value

DUP - Duplicate Sample

VOCs - Volatile Organic Compounds

SVOCs - Semivolatile Organic Compounds

PCBs - Polychlorinated Biphenyls

PFAS - Per- and Polyfluoroalkyl Substances

NE - No exceedance

ND - No detection

NA - Not analyzed for by laboratory

ft bls - Feet below land surface

N

50' 0 50'

SB-2	2/7/23	2/7/23
Depth (ft bls)	0 - 2	20 - 22
VOCs		
1,2,4-Trimethylbenzene	ND	**4**
Xylenes (total)	ND	**0.4**
Metals		
Arsenic	**23.8**	NE
Lead	**820**	NE
Mercury	**2.65**	ND
Nickel	NE	**47.8**
Selenium	**11**	ND
Zinc	**218**	NE

RXSB-3	09/26/2023
Depth (ft bls)	0 - 2
Metals	
Lead	**196**
Mercury	**0.55**
Zinc	**123**

RXSB-2	09/26/2023
Depth (ft bls)	0 - 1.5
SVOCs	
Benzo(A)Anthracene	**1.5**
Benzo(A)Pyrene	**1.6**
Benzo(B)Fluoranthene	**2.2**
Chrysene	**1.4**
Indeno(1,2,3-C,D)Pyrene	**0.87**
Metals	
Barium	**391**
Copper	**50.3**
Lead	**733**
Mercury	**1.2**
Zinc	**304**

RXSB-1	09/26/2023
Depth (ft bls)	0 - 2
Metals	
Lead	**186**
Mercury	**0.44**
Nickel	**30.3**
Zinc	**132**

Title:

EXCEEDANCES IN SOIL SAMPLES

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 10/10/2023	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	4
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y101.02.DWG		

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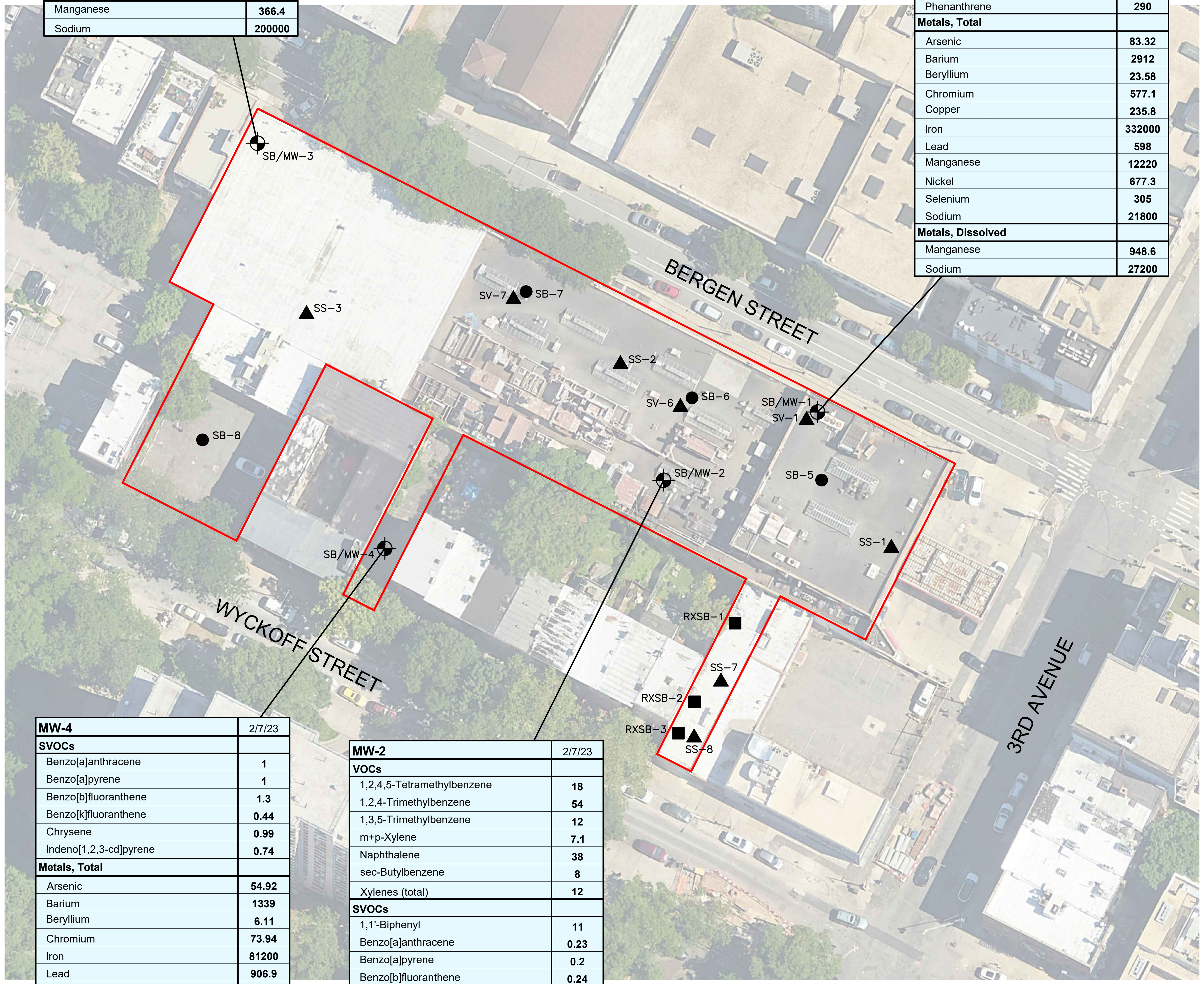
MW-3	2/7/23
SVOCs	
Benzo[a]anthracene	**1.3**
Benzo[a]pyrene	**1.2**
Benzo[b]fluoranthene	**1.5**
Benzo[k]fluoranthene	**0.42**
Chrysene	**1.2**
Indeno[1,2,3-cd]pyrene	**0.86**
Metals, Total	
Iron	**20500**
Lead	**228.7**
Manganese	**1743**
Nickel	**183.2**
Selenium	**14.3**
Sodium	**198000**
Metals, Dissolved	
Manganese	**366.4**
Sodium	**200000**

MW-1	2/7/23
VOCs	
1,2,4,5-Tetramethylbenzene	**78**
Isopropylbenzene	**30**
n-Butylbenzene	**27**
n-Propylbenzene	**64**
sec-Butylbenzene	**23**
SVOCs	
Benzo[a]anthracene	**8.7**
Benzo[a]pyrene	**7.1**
Benzo[b]fluoranthene	**8.3**
Benzo[k]fluoranthene	**2.5**
Bis(2-ethylhexyl) phthalate	**7.8**
Chrysene	**8.5**
Fluorene	**57**
Indeno[1,2,3-cd]pyrene	**4.5**
Phenanthrene	**290**
Metals, Total	
Arsenic	**83.32**
Barium	**2912**
Beryllium	**23.58**
Chromium	**577.1**
Copper	**235.8**
Iron	**332000**
Lead	**598**
Manganese	**12220**
Nickel	**677.3**
Selenium	**305**
Sodium	**21800**
Metals, Dissolved	
Manganese	**948.6**
Sodium	**27200**



MW-4	2/7/23
SVOCs	
Benzo[a]anthracene	**1**
Benzo[a]pyrene	**1**
Benzo[b]fluoranthene	**1.3**
Benzo[k]fluoranthene	**0.44**
Chrysene	**0.99**
Indeno[1,2,3-cd]pyrene	**0.74**
Metals, Total	
Arsenic	**54.92**
Barium	**1339**
Beryllium	**6.11**
Chromium	**73.94**
Iron	**81200**
Lead	**906.9**
Manganese	**12500**
Nickel	**240.7**
Selenium	**69.7**
Sodium	**36900**
Thallium	**0.53 J**
Metals, Dissolved	
Manganese	**5033**
Sodium	**37500**

MW-2	2/7/23
VOCs	
1,2,4,5-Tetramethylbenzene	**18**
1,2,4-Trimethylbenzene	**54**
1,3,5-Trimethylbenzene	**12**
m+p-Xylene	**7.1**
Naphthalene	**38**
sec-Butylbenzene	**8**
Xylenes (total)	**12**
SVOCs	
1,1'-Biphenyl	**11**
Benzo[a]anthracene	**0.23**
Benzo[a]pyrene	**0.2**
Benzo[b]fluoranthene	**0.24**
Benzo[k]fluoranthene	**0.08 J**
Chrysene	**0.22**
Indeno[1,2,3-cd]pyrene	**0.14**
Naphthalene	**13**
Metals, Total	
Arsenic	**48.29**
Iron	**41000**
Lead	**1702**
Manganese	**2067**
Mercury	**0.87**
Selenium	**31.7**
Thallium	**0.57 J**
Metals, Dissolved	
Manganese	**1446**
PFAS (Concentrations in ng/L)	
Perfluorooctanesulfonic acid (PFOS)	**5.06 F**
Perfluorooctanoic acid (PFOA)	**13**

Parameter	NYSDEC AWQSGV
VOCs	
1,2,4,5-Tetramethylbenzene	**5**
1,2,4-Trimethylbenzene	**5**
1,3,5-Trimethylbenzene	**5**
Isopropylbenzene	**5**
m+p-Xylene	**5**
Naphthalene	**10**
n-Butylbenzene	**5**
n-Propylbenzene	**5**
sec-Butylbenzene	**5**
Xylenes (total)	**5**
SVOCs	
1,1'-Biphenyl	**5**
Benzo[a]anthracene	**0.002**
Benzo[a]pyrene	**0**
Benzo[b]fluoranthene	**0.002**
Benzo[k]fluoranthene	**0.002**
Bis(2-ethylhexyl) phthalate	**5**
Chrysene	**0.002**
Fluorene	**50**
Indeno[1,2,3-cd]pyrene	**0.002**
Naphthalene	**10**
Phenanthrene	**50**
Metals, Total	
Arsenic	**25**
Barium	**1000**
Beryllium	**3**
Chromium	**50**
Copper	**200**
Iron	**300**
Lead	**25**
Manganese	**300**
Mercury	**0.7**
Nickel	**100**
Selenium	**10**
Sodium	**20000**
Thallium	**0.5**
Metals, Dissolved	
Arsenic	**25**
Barium	**1000**
Beryllium	**3**
Chromium	**50**
Copper	**200**
Iron	**300**
Lead	**25**
Manganese	**300**
Mercury	**0.7**
Nickel	**100**
Selenium	**10**
Sodium	**20000**
Thallium	**0.5**
PCBs	ND
PFAS (Concentrations in ng/L)	
Perfluorooctanesulfonic acid (PFOS)	**2.7**
Perfluorooctanoic acid (PFOA)	**6.7**

LEGEND

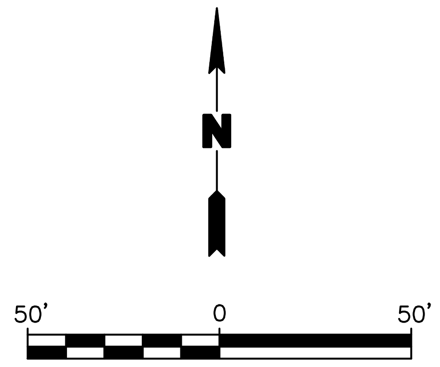
🟥	APPROXIMATE SITE BOUNDARY
SB/MW-1 ⊕	GROUNDWATER AND SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SB-6 ●	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SV-6 ▲	SOIL VAPOR SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
RXSB-1 ■	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY ROUX)

TYPICAL DATA BOX INFORMATION

SAMPLE ID# → MW-4; SAMPLE DATE → 2/7/23; ANALYTES; CONCENTRATIONS

MW-4	2/7/23
SVOCs	
Benzo[a]anthracene	**1**
Benzo[a]pyrene	**1**
Benzo[b]fluoranthene	**1.3**
Benzo[k]fluoranthene	**0.44**
Chrysene	**0.99**
Indeno[1,2,3-cd]pyrene	**0.74**

µg/L - Micrograms per liter
ng/L - Nanograms per liter
NYSDEC - New York State Department of Environmental Conservation
AWQSGVs - Ambient Water-Quality Standards and Guidance Values
-- Not detected above NYSDEC AWQSGV
B - Found in laboratory blank
D - Dilution
E - Exceeds calibration limit
F - The ratio of quantifier ion response falls outside of the laboratory criteria. results are considered to be an estimated maximum concentration
J - Estimated value
DUP - Duplicate Sample
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls
PFAS - Per- and Polyfluoroalkyl Substances
NE - No exceedances
ND - No detection



Title:

EXCEEDANCES IN GROUNDWATER SAMPLES

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 11/30/2023	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	5
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y100.01.DWG		

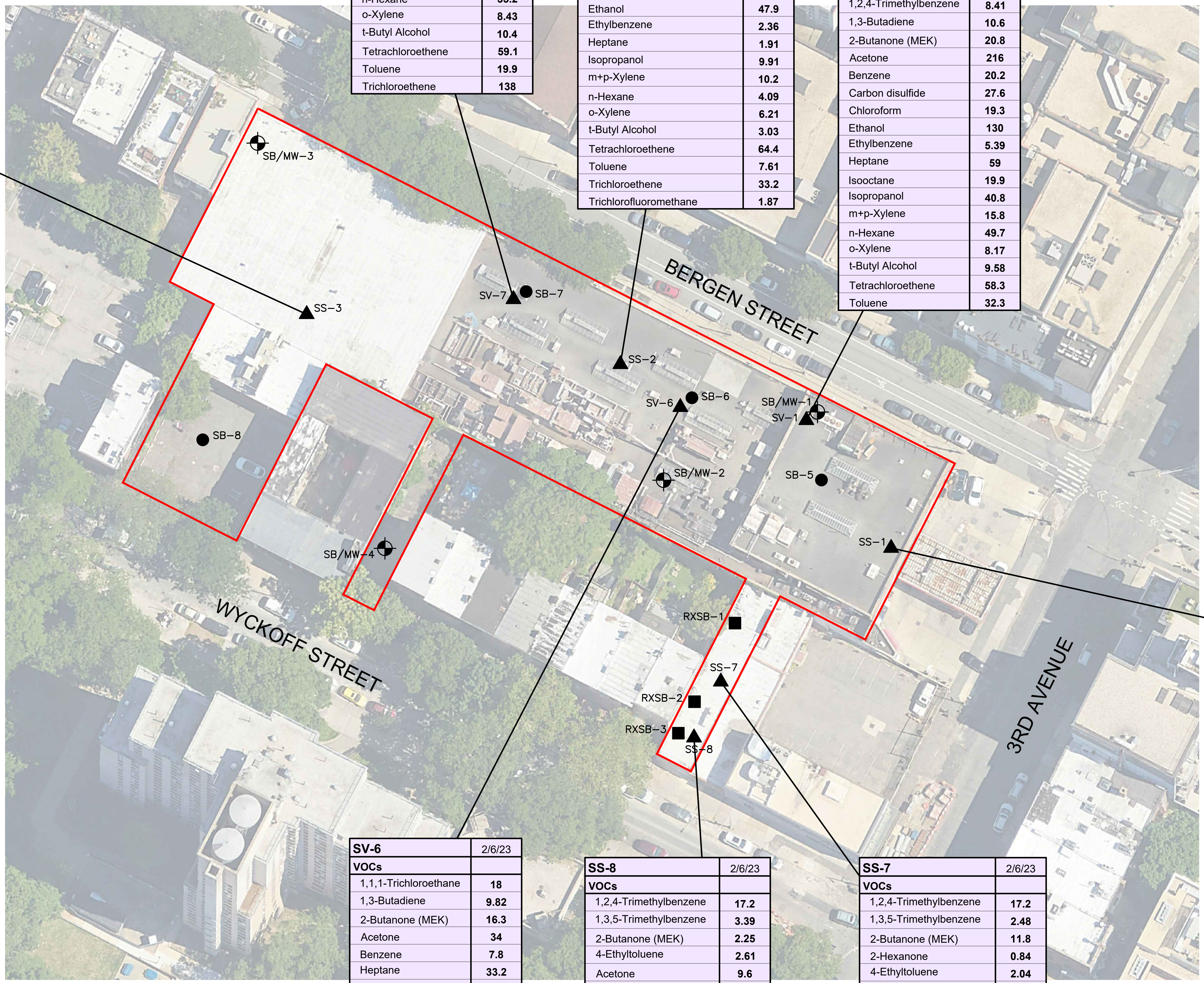
V:\CAD\PROJECTS\4442Y\0001Y\100\4442.0001Y100.01.DWG GMILTON

SV-7	2/6/23
VOCs	
1,1,1-Trichloroethane	**64.4**
1,2,4-Trimethylbenzene	**8.36**
1,3-Butadiene	**10.9**
2-Butanone (MEK)	**47.8**
Acetone	**129**
Benzene	**11.1**
Carbon disulfide	**8.59**
Chloroform	**225**
Cyclohexane	**9.02**
Heptane	**65.6**
Isooctane	**11.5**
Isopropanol	**9.05**
m+p-Xylene	**12.3**
n-Hexane	**35.2**
o-Xylene	**8.43**
t-Butyl Alcohol	**10.4**
Tetrachloroethene	**59.1**
Toluene	**19.9**
Trichloroethene	**138**

SS-2	2/6/23
VOCs	
1,1,1-Trichloroethane	**26.3**
1,2,4-Trimethylbenzene	**11**
1,3,5-Trimethylbenzene	**2.8**
2-Butanone (MEK)	**7.4**
4-Ethyltoluene	**1.54**
4-Methyl-2-pentanone (MIBK)	**11**
Acetone	**153**
Benzene	**2.05**
Carbon disulfide	**2.29**
Chloroform	**5.91**
Dichlorodifluoromethane	**2.33**
Ethanol	**47.9**
Ethylbenzene	**2.36**
Heptane	**1.91**
Isopropanol	**9.91**
m+p-Xylene	**10.2**
n-Hexane	**4.09**
o-Xylene	**6.21**
t-Butyl Alcohol	**3.03**
Tetrachloroethene	**64.4**
Toluene	**7.61**
Trichloroethene	**33.2**
Trichlorofluoromethane	**1.87**

SS-3	2/6/23
VOCs	
1,1,1-Trichloroethane	**22.8**
1,2,4-Trimethylbenzene	**16.8**
1,3,5-Trimethylbenzene	**2.34**
2-Butanone (MEK)	**33.9**
4-Ethyltoluene	**2.27**
Acetone	**359**
Benzene	**53.7**
Carbon disulfide	**5.42**
Chloroform	**3.86**
Chloromethane	**0.966**
Cyclohexane	**46.5**
Dichlorodifluoromethane	**2.44**
Ethanol	**166**
Ethyl Acetate	**2.34**
Ethylbenzene	**7.38**
Heptane	**23.4**
Isopropanol	**37.4**
m+p-Xylene	**19.4**
n-Hexane	**17.8**
o-Xylene	**11.5**
Styrene	**3.28**
t-Butyl Alcohol	**4.09**
Tetrachloroethene	**48.2**
Tetrahydrofuran	**3.24**
Toluene	**85.5**
Trichloroethene	**8.33**
Trichlorofluoromethane	**4.98**

SV-1	2/6/23
VOCs	
1,2,4-Trimethylbenzene	**8.41**
1,3-Butadiene	**10.6**
2-Butanone (MEK)	**20.8**
Acetone	**216**
Benzene	**20.2**
Carbon disulfide	**27.6**
Chloroform	**19.3**
Ethanol	**130**
Ethylbenzene	**5.39**
Heptane	**59**
Isooctane	**19.9**
Isopropanol	**40.8**
m+p-Xylene	**15.8**
n-Hexane	**49.7**
o-Xylene	**8.17**
t-Butyl Alcohol	**9.58**
Tetrachloroethene	**58.3**
Toluene	**32.3**



SS-1	2/6/23
VOCs	
1,2,4-Trimethylbenzene	**14.6**
1,3,5-Trimethylbenzene	**2.94**
2-Butanone (MEK)	**4.98**
4-Ethyltoluene	**2.36**
Acetone	**21.4**
Benzene	**1.02**
Carbon disulfide	**2.56**
Dichlorodifluoromethane	**2.3**
Ethylbenzene	**36.4**
Heptane	**1.16**
Isopropanol	**2.61**
m+p-Xylene	**121**
Methylene chloride	**4**
n-Hexane	**1.36**
o-Xylene	**12.1**
t-Butyl Alcohol	**4.43**
Tetrachloroethene	**43.3**
Toluene	**11.2**
Trichloroethene	**1.49**
Trichlorofluoromethane	**1.63**

SV-6	2/6/23
VOCs	
1,1,1-Trichloroethane	**18**
1,3-Butadiene	**9.82**
2-Butanone (MEK)	**16.3**
Acetone	**34**
Benzene	**7.8**
Heptane	**33.2**
Isooctane	**10**
n-Hexane	**16**
Tetrachloroethene	**59.9**
Toluene	**15.6**

SS-8	2/6/23
VOCs	
1,2,4-Trimethylbenzene	**17.2**
1,3,5-Trimethylbenzene	**3.39**
2-Butanone (MEK)	**2.25**
4-Ethyltoluene	**2.61**
Acetone	**9.6**
Benzene	**1.01**
Dichlorodifluoromethane	**2.21**
Ethylbenzene	**2.37**
Heptane	**0.926**
Isooctane	**2.97**
Isopropanol	**1.24**
m+p-Xylene	**11.6**
n-Hexane	**0.948**
o-Xylene	**5.43**
t-Butyl Alcohol	**2.96**
Tetrachloroethene	**888**
Toluene	**6.03**
Trichloroethene	**1.5**
Trichlorofluoromethane	**1.4**

SS-7	2/6/23
VOCs	
1,2,4-Trimethylbenzene	**17.2**
1,3,5-Trimethylbenzene	**2.48**
2-Butanone (MEK)	**11.8**
2-Hexanone	**0.84**
4-Ethyltoluene	**2.04**
Acetone	**47.3**
Benzene	**1.89**
Carbon disulfide	**9.34**
Chloroform	**2.25**
Dichlorodifluoromethane	**2.59**
Ethylbenzene	**2.4**
Heptane	**2.62**
Isopropanol	**2.11**
m+p-Xylene	**9.6**
n-Hexane	**2.81**
o-Xylene	**3.83**
t-Butyl Alcohol	**20.1**
Tetrachloroethene	**610**
Toluene	**10.1**
Trichloroethene	**3.79**
Trichlorofluoromethane	**2.05**

LEGEND

🟥	APPROXIMATE SITE BOUNDARY
SB/MW−1 ⊕	GROUNDWATER AND SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SB−6 ●	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SV−6 ▲	SOIL VAPOR SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
RXSB−1 ■	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY ROUX)

TYPICAL DATA BOX INFORMATION

SAMPLE ID# →
← SAMPLE DATE
ANALYTES —
— CONCENTRATIONS

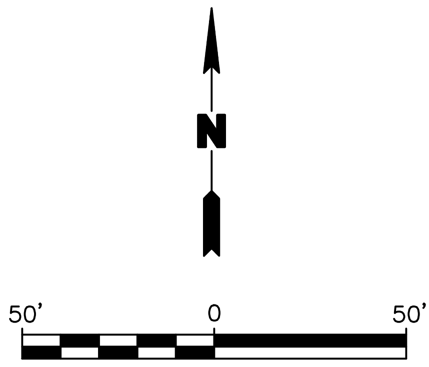
SV-6	2/6/23
VOCs	
1,1,1-Trichloroethane	**18**
1,3-Butadiene	**9.82**
2-Butanone (MEK)	**16.3**
Acetone	**34**
Benzene	**7.8**
Heptane	**33.2**
Isooctane	**10**
n-Hexane	**16**
Tetrachloroethene	**59.9**
Toluene	**15.6**

Concentrations in μg/m^3

μg/m^3 - Micrograms per cubic meter

VOCs - Volatile Organic Compounds

ND - Compound was analyzed for but not detected



Title:

DETECTIONS IN SOIL VAPOR SAMPLES

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 10/10/2023	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	6
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y101.02.DWG		

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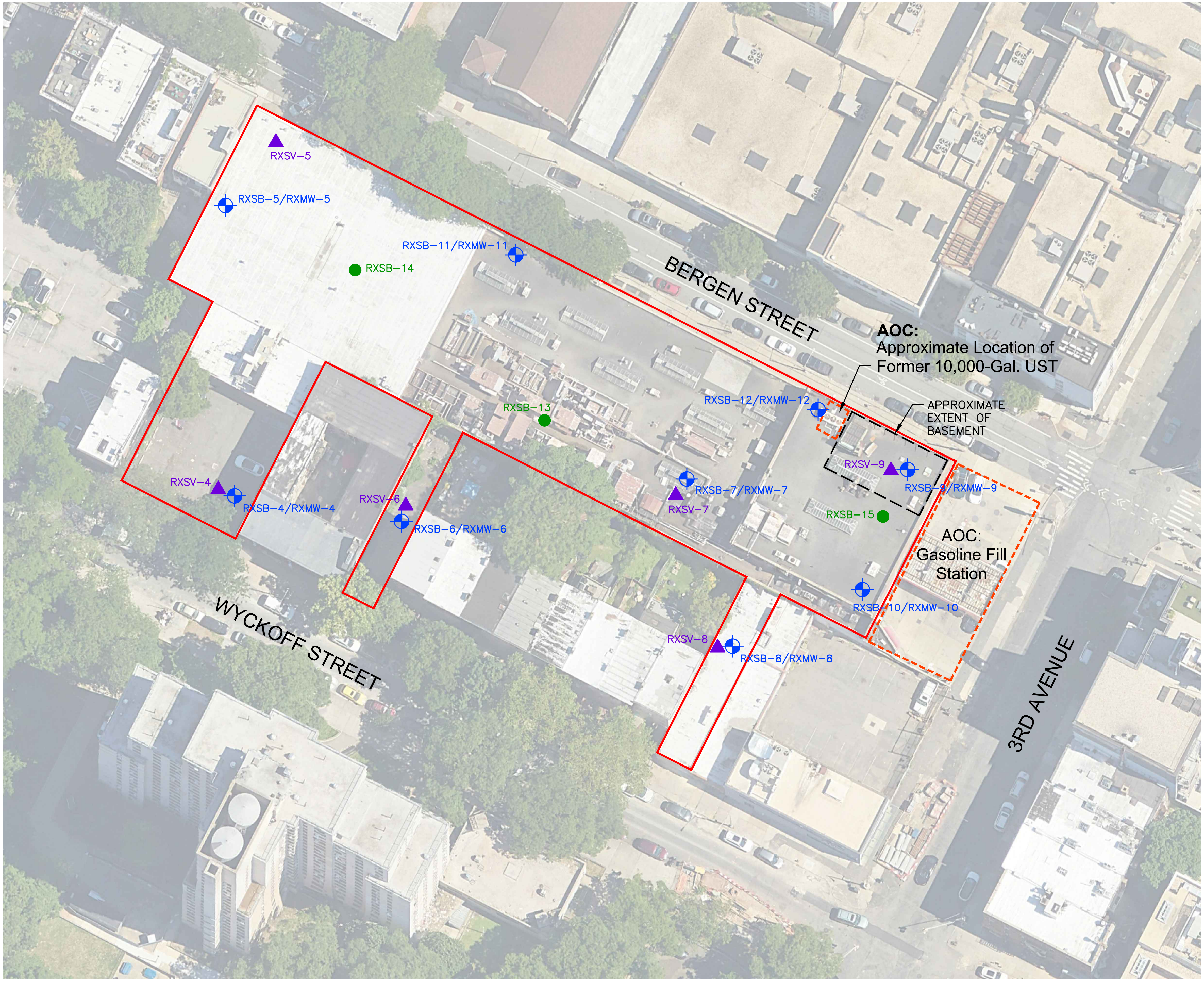

LEGEND

- APPROXIMATE SITE BOUNDARY
- ⌖ PROPOSED LOCATION OF SOIL BORING AND MONITORING WELL
- ● PROPOSED LOCATION OF SOIL BORING
- ▲ PROPOSED LOCATION OF SOIL VAPOR POINT
- ⬚ APPROXIMATE EXTENT OF AOC

N

50' 0 50'

Title:

PROPOSED RI SAMPLE LOCATIONS

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 5/31/2024	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	7
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y101.03.DWG		

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Remedial Investigation Work Plan
Diagravure Film Manufacturing Site
268 Bergen Street, 287 Wyckoff Street and
N/A Wyckoff Street, Brooklyn, New York
NYSDEC Project Number C224403

APPENDICES

A. Previous Environmental Investigations
B. Community Air Monitoring Plan
C. Quality Assurance Project Plan/Field Sampling Plan
D. Site-Specific Health and Safety Plan

APPENDIX A

Previous Environmental Investigations
(Submitted Under Separate Cover)

APPENDIX B

Community Air Monitoring Plan

Community Air Monitoring Plan

Diagravure Film Manufacturing Site
NYSDEC Project Number C224403
268 Bergen Street,
287 Wyckoff Street, and
N/A Wyckoff Street
Brooklyn, New York

June 7, 2024

Prepared for:

Bergen St. Equity LLC
505 Flushing Avenue #1H
Brooklyn, New York 11205

Prepared by:

Roux Environmental Engineering and Geology, D.P.C.
209 Shafter Street
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Appendices

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux) on behalf of Bergen St. Equity LLC (the "Applicant"), has developed a project specific Community Air Monitoring Plan (CAMP) to implement real time monitoring at the Diagravure Film Manufacturing Site, located at 268 Bergen Street, 287 Wyckoff Street, and N/A Wyckoff Street, Brooklyn, New York (Site), which occupies Tax Lot 19, 42, and 51 of Tax Block 388, during remedial investigation activities.

The monitoring program will be implemented at all times during which earth disturbance activities are occurring. The CAMP is designed to provide a measure of protection for the downwind community and on-Site workers not directly involved with the subject work activities from potential airborne contaminant releases as a direct result of remedial and construction activities. This plan is consistent with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan guidance document.

The specifics of the CAMP are presented in the following four (4) sections:

- 1.1 Volatile Organic Compound (VOC) Monitoring Approach
- 1.2 Particulate Monitoring Approach
- 1.3 Meteorological Monitoring Approach
- 1.4 Available Suppression Techniques

1.1 VOC Monitoring Approach

Total VOC concentrations in air will be monitored continuously at a location downwind and upwind of the investigation activities during all outdoor ground intrusive activities. The VOC monitoring equipment will be located at temporary monitoring stations that will be established daily based on Site logistics and weather conditions. During ground intrusive activities conducted indoors, the breathing zone will be monitored for VOCs in the vicinity of all on-Site workers. The monitoring work will be conducted using MiniRAE 3000 (or equivalent) portable VOC monitors, or similar type monitors, for all VOC monitoring. The equipment will be calibrated at least once daily using isobutylene as the calibration gas. One (1) upwind and one (1) downwind monitor will be deployed each day. Each monitoring unit is equipped with an audible alarm to indicate exceedance of the action levels (as defined below and summarized in Table 1).

The equipment is capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total VOCs at the downwind perimeter, or in the localized breathing zone, of the Site 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.
- If the ambient air concentration of total VOCs at the downwind perimeter, or in the localized breathing zone, of the Site persists at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of VOCs identified, suppression techniques employed to abate emissions, and monitoring continued. After these steps, work activities can resume if the total organic vapor level at the Site perimeter is below 5 ppm over the background concentration for the 15-minute average. If levels are in excess of 25 ppm above background, identified contributing ground-intrusive activities will be halted and vapor suppression techniques will be evaluated and modified until monitoring indicates VOC levels at the Site perimeter are below 5 ppm over

background. Once VOC levels are below 5 ppm at the Site perimeter, work will resume with continued monitoring.

- All 15-minute readings will be recorded and be available for State Regulator (New York State Department of Environmental Conservation [NYSDEC] and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes will be recorded. If an exceedance of the action level occurs, an Action Limit Report (ALR) will be completed, identifying the monitoring device location, the measured VOC level, the activity causing the exceedance, meteorological conditions, and the corrective actions taken, as provided in Appendix A. Additionally, the NYSDEC and NYSDOH will be notified within 24 hours of the VOC ALR generation. Daily monitoring equipment locations and meteorological conditions will also be documented on the daily CAMP Monitoring Location Plan. All documentation will be kept on file at the Site.

1.2 Particulate Monitoring, Response Levels and Actions

Particulate concentrations will be monitored continuously during all outdoor ground-intrusive activities at temporary particulate monitoring stations set up at upwind and downwind locations. During ground intrusive activities conducted indoors, the breathing zone will be monitored for particulates in the vicinity of all on-Site workers. The particulate monitoring will 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 levels (as defined below and summarized in Table 1). Monitoring equipment will be TSI DustTrak II monitors or equivalent. A minimum of one (1) upwind and one (1) downwind monitor will be deployed during outdoor ground-intrusive activities, equipped with an omni-directional sampling inlet and a PM-10 sample head. During indoor ground-intrusive activities, one monitor will be deployed to monitor the breathing zone of onsite workers. The data logging averaging period will be set to 15-minutes with time and date stamp recording. Alarm averaging will be set at 90 micrograms per cubic meter (µg/m^3) per 15-minute period. This setting will allow proactive evaluation of Site conditions prior to reaching Action Levels of 100 µg/m^3 above background. The equipment will be outfitted with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities. The monitoring will be used to compare values to the following:

- If the downwind PM-10 particulate level is 100 µg/m^3 greater than background (upwind perimeter) for the 15-minute period, if the breathing-zone particulate level is 100 µg/m^3, or if airborne dust is observed leaving the Site, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind, or breathing zone, PM-10 particulate levels do not exceed 150 µg/m^3 above the upwind level and provided that no visible dust is migrating from the Site.
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 µg/m^3 above the upwind level, work must be stopped, a re-evaluation of activities initiated, and dust suppression techniques modified. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/m^3 of the upwind level and in preventing visible dust migration.

All 15-minute readings will be recorded and be available for State Regulator (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes will be recorded. If an exceedance of the action level occurs, an ALR will be completed, identifying the monitoring device location, the measured particulate concentration, the activity causing the exceedance, meteorological conditions, and the corrective actions taken, as provided in Appendix A. Daily monitoring equipment locations will also be documented on the daily CAMP Monitoring Location Plan. All documentation will be kept on file at the Site.

1.3 Meteorological Monitoring

Wind speed (estimated) and wind direction, will be approximated based on field observations of on-Site personnel. Meteorological data consisting of temperature, barometric pressure, and relative humidity will be recorded in the field book based upon publically available information from local weather stations.

1.4 Available Suppression Techniques

Odor Control

Due to the nature of the project, with intrusive activities occurring, the potential for generation of nuisance odors and the need for odor control may be necessary. If nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. Both NYSDEC and NYSDOH will be notified of all nuisance odor events and of all other complaints about the project.

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

Dust Control

Due to the nature of the project, the potential for generation of nuisance dust and the need for dust control may be necessary. Dust suppression will be achieved through the use of water for wetting excavation areas, if required. Water will be available on-Site at suitable supply and pressure for use in dust control.

1.5 Reporting

All recorded monitoring data will be downloaded, and field logged periodically, including action limit reports (if any) and daily CAMP monitoring location plans. All records will be maintained on-Site and available for NYSDEC/NYSDOH review. A summary of CAMP findings, including excursions, will be provided in the Daily and Monthly Reports. All CAMP monitoring records will be included in the overall Final Engineering Report (FER) that will be submitted to the NYSDEC and NYSDOH and will include all of the CAMP data collected, daily monitoring station location maps, and copies of the ALRs (if any). If an ALR is generated due to VOC exceedances, the NYSDEC and NYSDOH will be notified within 24 hours of the exceedance.

TABLE

Table 1. Action Limit Summary for VOCs and Particulates

Contaminant	Downwind Action Levels*	Action/Response
Volatile Organic Compounds (VOCs) (Monitoring Via Photoionization Detector and Odor Observation)	< 5 ppm	1. Resume work with continuing monitoring.
	5 ppm < level < 25 ppm	1. Work activities must be temporarily halted, source vapors must be identified, suppression techniques employed to abate emissions and monitoring continued. 2. After these steps, if VOC levels (200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or structure, whichever is less) is below 5 ppm over background, resume work.
	> 25 ppm	1. Identified contributing ground intrusive activities must be halted and vapor suppression techniques must be evaluated and modified until monitoring indicates VOC levels below the action level. 2. After these steps, if VOC levels (half the distance to the nearest potential receptor or structure) are below 5 ppm over background, resume work.
Particulates (Monitoring Via Particulate Meter and Observation)	< 100 ug/m^3	1. If dust is observed leaving the work area, then dust control techniques must be implemented or additional controls used.
	100 ug/m3 < level < 150 ug/m^3	1. Employ dust suppression techniques. 2. Work may continue with dust suppression techniques provided that downwind PM-10 particulate concentration do not exceed 150 ug/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
	> 150 ug/m^3	1. STOP work 2. Re-evaluate activities, modify dust suppression techniques. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 ug/m^3 of the upwind level and in preventing visible dust migration.

* Instantaneous readings above background. Particulate readings are based on the respirable (PM-10) fraction. Background readings are taken at upwind locations relative to Work Areas or Exclusion Zones.

APPENDIX A

Action Limit Report

ACTION LIMIT REPORT

Project Location: 280 Bergen St.
280 Bergen Street, Brooklyn, New York

Date: ____________________ Time: ____________________

Name: ____

Contaminant: PM-10: ______________ VOC: ____________________

Wind Speed: ______________ Wind Direction: ____________________

Temperature: ______________ Barometric Pressure: ____________________

DOWNWIND DATA

Monitor ID #: ______________ Location: ______________ Level Reported: __________

Monitor ID#: ______________ Location: ______________ Level Reported: __________

UPWIND DATA

Monitor ID #: ______________ Location: ______________ Level Reported: __________

Monitor ID#: ______________ Location: ______________ Level Reported: __________

BACKGROUND CORRECTED LEVELS

Monitor ID #: ______________ Location: ______________ Level Reported: __________

Monitor ID#: ______________ Location: ______________ Level Reported: __________

ACTIVITY DESCRIPTION

CORRECTIVE ACTION TAKEN

ROUX

TABLE

1. Action Limit Summary for VOCs and Particulates

Table 1. Action Limit Summary for VOCs and Particulates

Contaminant	Downwind Action Levels*	Action/Response
Volatile Organic Compounds (VOCs) (Monitoring Via Photoionization Detector and Odor Observation)	< 5 ppm	1. Resume work with continuing monitoring.
	5 ppm < level < 25 ppm	1. Work activities must be temporarily halted, source vapors must be identified, suppression techniques employed to abate emissions and monitoring continued. 2. After these steps, if VOC levels (200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or structure, whichever is less) is below 5 ppm over background, resume work.
	> 25 ppm	1. Identified contributing ground intrusive activities must be halted and vapor suppression techniques must be evaluated and modified until monitoring indicates VOC levels below the action level. 2. After these steps, if VOC levels (half the distance to the nearest potential receptor or structure) are below 5 ppm over background, resume work.
Particulates (Monitoring Via Particulate Meter and Observation)	< 100 ug/m^3	1. If dust is observed leaving the work area, then dust control techniques must be implemented or additional controls used.
	100 ug/m3 < level < 150 ug/m^3	1. Employ dust suppression techniques. 2. Work may continue with dust suppression techniques provided that downwind PM-10 particulate concentration do not exceed 150 ug/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
	> 150 ug/m^3	1. STOP work 2. Re-evaluate activities, modify dust suppression techniques. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 ug/m^3 of the upwind level and in preventing visible dust migration.

* Instantaneous readings above background. Particulate readings are based on the respirable (PM-10) fraction. Background readings are taken at upwind locations relative to Work Areas or Exclusion Zones.

APPENDIX A

Action Limit Report

ACTION LIMIT REPORT

Project Location: 280 Bergen St.
280 Bergen Street, Brooklyn, New York

Date: ____________________ Time: ____________________

Name: ____

Contaminant: PM-10: __________ VOC: ____________________

Wind Speed: __________ Wind Direction: ____________________

Temperature: __________ Barometric Pressure: ____________________

DOWNWIND DATA

Monitor ID #: __________ Location: __________ Level Reported: __________

Monitor ID#: __________ Location: __________ Level Reported: __________

UPWIND DATA

Monitor ID #: __________ Location: __________ Level Reported: __________

Monitor ID#: __________ Location: __________ Level Reported: __________

BACKGROUND CORRECTED LEVELS

Monitor ID #: __________ Location: __________ Level Reported: __________

Monitor ID#: __________ Location: __________ Level Reported: __________

ACTIVITY DESCRIPTION

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CORRECTIVE ACTION TAKEN

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APPENDIX C

Quality Assurance Project Plan/Field Sampling Plan

ROUX

Quality Assurance Project Plan/Field Sampling Plan

Diagravure Film Manufacturing Site
NYSDEC Project Number C224403
268 Bergen Street,
287 Wyckoff Street, and
N/A Wyckoff Street
Brooklyn, New York

June 7, 2024

Prepared for:

Bergen St. Equity LLC
505 Flushing Avenue #1H
Brooklyn, New York 11205

Prepared by:

Roux Environmental Engineering and Geology, D.P.C.
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Islandia, New York 11749

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Figures

Tables

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Attachments

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux), on behalf of Bergen St. Equity LLC (The Applicant), has prepared this Quality Assurance Project Plan/Field Sampling Plan (QAPP/FSP) to describe the measures that will be taken to ensure that the data generated during performance of the Remedial Investigation (RI) at the Diagravure Film Manufacturing Site, located at 268 Bergen Street, 287 Wyckoff Street and N/A Wyckoff Street, Brooklyn, New York (Site) are of quality sufficient to meet project-specific data quality objectives (DQOs). This QAPP/FSP also includes field sampling procedures.

An application for the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) is being submitted concurrently with this Remedial Investigation Work Plan (RIWP), and a BCP Site number will be assigned to the Site upon acceptance of the Brownfields Cleanup Agreement (BCA). This QAPP/FSP was prepared in accordance with the guidance provided in NYSDEC Technical Guidance DER-10 Technical Guidance for Site Investigation and Remediation (DER-10), the NYSDEC BCP Guide, and the United States Environmental Protection Agency's (USEPA's) Guidance for the Data Quality Objectives Process (EPA QA/G 4).

1.1 Purpose

The QAPP/FSP describes in detail the field sampling and quality assurance/quality control (QA/QC) methods to be used during soil, soil vapor, and groundwater sampling tasks performed during the RI.

This QAPP/FSP provides guidelines and procedures to be followed by field personnel during performance of sampling during the RI. Information contained in this QAPP/FSP relates to:

- sampling objectives (Section 2);
- project organization (Section 3);
- sample media, sampling locations, analytical suites, sampling frequencies and analytical laboratory (Section 4);
- field sampling procedures (Section 5);
- sample handling, sample analysis, and quality assurance/quality control (Section 6); and
- site control procedures and decontamination (Section 7).

2. Sampling Objectives

The objective of the proposed sampling is to determine the nature and extent of the known contamination at the Site, to evaluate any additional areas of concern (AOCs), and to obtain a current representation of the environmental conditions at the Site.

Previous environmental consultants have performed a Phase I ESA, preliminary Site reconnaissance and investigation and have identified AOCs. These areas will be further investigated as part of the RI. An inspection of the existing Site conditions will be conducted to determine final locations of soil borings, monitoring wells, and vapor sampling points based on actual field conditions.

Sampling procedures are discussed in Section 5 of this QAPP/FSP. A discussion of the DQOs and quality assurance/quality control is provided in Section 6.

3. Project Organization

A general and generic summary of the overall management structure and responsibilities of project team members are presented below. Professional profiles for the team are provided in Attachment 1.

Project Principal

Robert Kovacs, P.G. will serve as Project Principal. The Project Principal is responsible for defining project objectives and bears ultimate responsibility for the successful completion of the investigation.

Remedial Engineer

The Remedial Engineer for this project will be Omar Ramotar, P.E. The Remedial Engineer is a registered professional engineer licensed by the State of New York. The Remedial Engineer will have primary direct responsibility for implementation of the RI and future remedial program for the Site. The Remedial Engineer will certify in the Remedial Investigation Report (RIR) that the investigation activities were observed by qualified environmental professionals under her supervision as well as any other relevant provisions of ECL 27-1419 have been achieved in full conformance with the RI.

Project Manager

Julia Michaels of Roux will serve as Project Manager. The Project Manager will provide overall management for the implementation of the scope of work and will coordinate all field activities. The Project Manager is also responsible for data review/interpretation and report preparation.

Field Team Leader

The Field Team Leader will be determined prior to the start of work. The Field Team Leader bears the responsibility for the successful execution of the field program. The Field Team Leader will direct the activities of the technical staff in the field, as well as all subcontractors. The Field Team Leader will also assist in the interpretation of data and in report preparation. The Field Team Leader reports to the Project Manager.

Laboratory Project Manager

The Laboratory Project Manager will be determined prior to the start of work. The Laboratory Project Manager is responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of the laboratory staff. The Laboratory Project Manager will ensure that quality assurance procedures are followed and that an acceptable laboratory report is prepared and submitted. The Laboratory Project Manager reports to the Project Principal and Project Manager.

Quality Assurance Officer

Rachel Henke of Roux will serve as the Quality Assurance Officer (QAO) for this project. The QAO is responsible for conducting reviews, inspections, and audits to ensure that the data collection is conducted in accordance with the FSP and QAPP. The QAO's responsibilities range from ensuring effective field equipment decontamination procedures and proper sample collection to the review of all laboratory analytical data for completeness and usefulness. The QAO reports to the Project Manager and makes independent recommendations to the Field Team Leader.

4. Sample Media, Locations, Analytical Suites, and Frequency

The media to be sampled during the RI include soil, groundwater, and soil vapor. Sampling locations, analytical suites, and frequency may vary by medium. The proposed sample locations, depths, analytical suites and rational for sampling are presented in Tables 1, 2, and 3 for soil, groundwater, and soil vapor, respectively, and on Figure 1.

A discussion of the sampling schedule for each medium is provided below, while the assumed number of field samples to be collected for each medium, including quality control (QC) samples, is shown in Tables 4 and 5. Specifics regarding the collection of samples at each location and for each task are provided in Section 5 of this QAPP/FSP.

4.1 Soil Sampling

Soil samples are to be used to characterize the soil conditions for the AOCs at the Site, fill existing data gaps in vertical delineation of contamination, and to collect the data sufficient to define the nature and extent of impacted soils. Up to 32 soil samples from 11 soil borings will be collected in a manner consistent with this QAPP/FSP. As part of this RIWP, 11 soil borings are proposed to be installed at the locations shown in Figure 1.

Table 1, 2, and 3 provides details for the soil sampling locations that are proposed as part of this RIWP.

If odor/ visual evidence of contamination or elevated photoionization detector (PID) readings are noted, additional samples will be collected from the interval that exhibits the highest contamination.

4.2 Groundwater Sampling

To characterize onsite groundwater flow and quality conditions, seven permanent groundwater monitoring wells will be installed across the Site. Based on data from previous environmental investigations conducted by VHB, the average depth to groundwater is approximately 18-20 ft bls. The seven permanent groundwater monitoring wells (RXMW-1 through RXMW-7) will be installed to an estimated maximum depth of 25-27 feet below land surface (ft bls). All monitoring wells will be installed with a ten-foot well screen bridging the water table (i.e., three feet of screen above the water table and seven feet of well screen below). The proposed permanent groundwater monitoring well locations are shown on Figure 1 and permanent monitoring well installation and groundwater sampling procedures are outlined below in Section 5.2.

Groundwater samples will be collected from the all monitoring wells and submitted for laboratory analysis for TCL + 30/TAL analysis (including filtered and unfiltered metals) and the emerging contaminants (ECs) 1,4-Dioxane and Per- and Polyfluoroalkyl Substances (PFAS), which include the 40 compounds listed in the NYSDEC April 2023 Groundwater Sampling for Emerging Contaminants Guidance (NYSDEC April 2023 Guidance, provided as Attachment 4). The TestAmerica Standard Operating Procedures (SOPs) for completing Emerging Contaminants (ECs) analysis and reporting limits/minimum detection limits for EC compounds are included in Table 7 and Attachment 2. Field parameters (e.g., pH, dissolved oxygen, oxidation-reduction potential [ORP], etc.) will also be collected in the field using a water quality meter during purging prior to sample collection.

4.3 Soil Vapor Sampling

Four soil vapor samples (RXSV-1 through RXSV-4) will be collected during the RI to evaluate soil vapor conditions at the Site. The proposed soil vapor sampling locations are shown on Figure 1. All soil vapor samples will be collected in accordance with the October 2006 New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH Guidance), updated in February 2024 and June 2015 USEPA Soil Vapor Guidance. All soil vapor samples will be collected from a depth of approximately 5 ft bls. All soil vapor samples will be analyzed for VOCs using USEPA Method TO-15. Soil vapor point installation and soil vapor sampling procedures are outlined below is Section 5.3.

5. Field Sampling Procedures

This section provides a detailed discussion of the field procedures to be used during sampling of the various media being evaluated as part of the RI (i.e., soil, groundwater, and soil vapor). As discussed, the sample locations are shown on Figure 1 and additional information including intervals to be sampled and sample rationale is provided in Tables 1 through 3. Additional details regarding sampling procedures and protocols are described in Roux's relevant SOPs, which are provided in Attachment 3.

5.1 Soil Sampling and Permanent Monitoring Well Installation

Details for the collection of soil samples and the installation of permanent monitoring wells are provided below. Boreholes will be pre-cleared to five ft bls using non-intrusive methods (i.e., hand auger, vacuum technology, etc.) prior to advancement of soil borings to verify the absence of potential underground utilities. Should a utility or other feature be observed during pre-clearance activities, the sampling location will be relocated to no greater than ten feet away from the original proposed location. Should the sampling location need to be located at a distance greater than ten feet from the original proposed location due to access constraints, Roux will contact the NYSDEC case manager to confirm.

5.1.1 Soil Sampling

Soil borings will be advanced using a GeoProbe® Direct-Push drill rig. Samples of the soil profile will be collected continuously from land surfance to a maximum depth of approximately 20 ft bls, as shown in Table 1.

The soil from each five foot interval will be observed for lithology and evidence of contamination (e.g., staining, odors, and/or visible free product) and placed immediately thereafter into large Ziploc®bags for recording headspace using a PID. After a minimum of 15 minutes for equilibration with the headspace in the Ziploc® bag, each sample will be screened for organic vapors using a PID equipped with a 10.6 eV lamp. Samples for possible VOC analysis will be placed in a laboratory-supplied jar or encore sampler prior to screening, due to the potential for loss of VOCs through volatilization. Soil samples will be collected according to Table 1a of the RIWP. These samples will be placed in the laboratory-supplied containers and shipped to the laboratory under chain of custody procedures in accordance with Roux's SOPs in Attachment 3.

Soil samples will also be analyzed for the NYSDEC-required ECs in addition to the Part 375/TCL plus 30/ TAL list. Additional necessary precautions will be taken when sampling for ECs in the field including, but not limited to:

- Using the proper field clothing or personal protective equipment (i.e., no materials will contain Gore-Tex or Tyvek);
- Avoid using sampling equipment components/containers making contact with aluminum foil, low density polyethylene (LDPE), glass, or polytetrafluoroethylene materials;
- Following PFAS field sampling guidelines (i.e., using sampling materials made from high density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon and using sharpies, permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
- Utilizing regular ice for sample presevation and only Alconox or Liquinox for decontamination.

Following sample collection, boreholes will be backfilled with soil cuttings with a bentonite plug near the top and capped with concrete. Contaminated soil cuttings, if encountered, will be placed in sealed and labeled U.S. Department of Transportation (DOT) approved 55-gallon drums pending characterization and off-site disposal at a permitted facility.

5.1.2 Permanent Monitoring Well Installation

Following soil sampling activities, seven permanent monitoring wells will be installed bridging the water table and to a maximum depth of approximately 25-27 ft bls. Monitoring wells will be constructed of 2 inch inside diameter, Schedule 40 polyvinyl chloride (PVC) casing and, 0.020 inch slot, machined screen. Well screens will be 10 feet long, and will be installed with three feet above and seven feet below the water table. A sand pack will be placed around the well screen, extending two feet above the top of the screened zone.

5.2 Groundwater Sampling

Prior to sampling, depth to water will be measured at each newly installed permanent well using an electronic water level meter with an accuracy of +/ 0.01 feet. All wells will then be purged and sampled using a submersible pump or low-flow method, or an alternative method, depending on the observed depth to groundwater and logistical issues. Purging and sampling will be performed consistent with USEPA low-flow sampling requirements. Field parameters (i.e., pH, dissolved oxygen, ORP, etc., as described in the USEPA low-flow sampling requirements) will be collected using a water quality meter with flow-through cell until parameters stabilized before samples are collected. Samples will be analyzed for TCL + 30/TAL as shown on Table 2.

Monitoring wells will also be analyzed for the NYSDEC-required ECs in addition to the Part 375/TCL plus 30/ TAL list. Similarly to the collection of soil samples for RCs, additional necessary precautions will be taken when groundwater sampling for ECs in the field including, but not limited to:

- Using the proper field clothing or personal protective equipment (i.e., no materials will contain Gore-Tex or Tyvek);
- Avoid using Grundfos and bladder pumps and sampling equipment components/containers making contact with aluminum foil, low density polyethylene (LDPE), glass, or polytetrafluoroethylene materials;
- Following PFAS field sampling guidelines (i.e., using sampling materials made from high density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon and using sharpies, permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
- Utilizing regular ice for sample presevation and only Alconox or Liquinox for decontamination.

All groundwater samples will be collected and placed in the laboratory-supplied containers and shipped to the laboratory under chain of custody procedures in accordance with Roux’s field sampling SOPs included as Attachment 3.

5.3 Soil Vapor Sampling

Four soil vapor samples will be collected during the RI to evaluate soil vapor concentrations at the Site. The soil vapor samples will be collected from a depth of 5 ft bls. New Teflon® lined tubing will be attached to an expendable soil vapor sampling point with a 6-inch stainless steel screen inside the rods, to prevent infiltration of ambient air. The soil vapor points will be backfilled with #2 Morie sand to approximately one foot above the screen. The remainder of the borehole will be backfilled with a cement/bentonite slurry to grade.

Prior to sample collection, the Teflon®-lined tubing will be purged of approximately two volumes of the tubing using a vacuum pump set at a rate of 0.2 liters per minute. A tracer gas (i.e., helium) will be used to enrich the atmosphere in the immediate vicinity of the sampling location in order to test the borehole seal and verify that ambient air is not being drawn into the sample in accordance with the procedures outlined in the NYSDOH Guidance. Following purging and verification with the tracer gas, the tubing will be connected to the pre-cleaned (batch-certified) laboratory supplied six-liter summa canister. All soil vapor samples will be collected using the canisters with regulators calibrated to collect samples over a 2-hour period and analyzed using USEPA Method TO-15 for VOCs.

6. Sample Handling and Analysis

To ensure quality data acquisition and collection of representative samples, there are selective procedures to minimize sample degradation or contamination. These include procedures for preservation of the samples, as well as sample packaging, shipping procedures, and QA/QC.

6.1 Field Sample Handling

A discussion of the proposed number and types of samples to be collected during each task, as well as the analyses to be performed, can be found in Section 4 of this QAPP/FSP. The types of containers, volumes, and preservation techniques for the aforementioned testing parameters are presented in Table 3.

6.2 Sample Custody Documentation

The purpose of documenting sample custody is to ensure that the integrity and handling of the samples is not subject to question. Sample custody will be maintained from the point of sampling through the analysis (and return of unused sample portion, if applicable).

Each individual collecting samples is personally responsible for the care and custody of the samples. All sample labels should be pre printed or filled out using waterproof ink. The technical staff will review all field activities with the Field Team Leader to determine whether proper custody procedures were followed during the field work and to decide if additional samples are required.

All samples being shipped offsite for analysis must be accompanied by a properly completed chain of custody form. The sample numbers will be listed on the chain of custody form. When transferring the possession of samples, individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to/from a secure storage area, and to the laboratory.

Samples will be packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and/or secured with strapping tape in at least two locations for shipment to the

6.3 Sample Shipment

If sample shipment is necessary, sample packaging and shipping procedures are based upon USEPA specifications, as well as DOT regulations. The procedures vary according to potential sample analytes, concentration, and matrix and are designed to provide optimum protection for the samples and the public. Sample packaging and shipment must be performed using the general outline described below.

All samples will be shipped within 24 hours of collection and will be preserved appropriately from the time of sample collection. A description of the sample packing and shipping procedures is presented below:

1. Prepare cooler(s) for shipment:
    - tape drain(s) of cooler shut;
    - affix “This Side Up” arrow labels and “Fragile” labels on each cooler; and
    - place mailing label with laboratory address on top of cooler(s).
2. Arrange sample containers in groups by sample number.

3. Ensure that all bottle labels are completed correctly. Place clear tape over bottle labels to prevent moisture accumulation from causing the label to peel off.
4. Arrange containers in front of assigned coolers.
5. Place packaging material approximately at the bottom of the cooler to act as a cushion for the sample containers.
6. Arrange containers in the cooler so that they are not in contact with the cooler or other samples.
7. Fill remaining spaces with packaging material.
8. Ensure all containers are firmly packed in packaging material.
9. If ice is required to preserve the samples, ice cubes should be repackaged in Ziploc® bags and placed on top of the packaging material.
10. Sign chain of custody form (or obtain signature) and indicate the time and date it was relinquished to courier as appropriate.
11. Separate chain of custody forms. Seal proper copies within a large Ziploc® bag and tape to inside cover of cooler. Retain copies of all forms.
12. Close lid and latch.
13. Secure each cooler using custody seals.
14. Tape cooler shut on both ends.
15. Relinquish to overnight delivery service as appropriate. Retain air bill receipt for project records. (Note: All samples will be shipped for “NEXT A.M.” delivery).

6.4 Quality Assurance/Quality Control

The primary intended use for the RI data is to characterize Site conditions and determine if remediation needs to be undertaken at the Site. The primary DQO of the soil, groundwater, and soil vapor programs, therefore, is that data be accurate and precise, and hence representative of the actual Site conditions. Accuracy refers to the ability of the laboratory to obtain a true value (i.e., compared to a standard) and is assessed through the use of laboratory quality control (QC) samples, including laboratory control samples and matrix spike samples, as well as through the use of surrogates, which are compounds not typically found in the environment that are injected into the samples prior to analysis. Precision refers to the ability to replicate a value and is assessed through both field and laboratory duplicate samples.

Sensitivity is also a critical issue in generating representative data. Laboratory equipment must be of sufficient sensitivity to detect target compounds and analytes at levels below NYSDEC standards and guidelines whenever possible. Equipment sensitivity can be decreased by field or laboratory contamination of samples, and by sample matrix effects. Assessment of instrument sensitivity is performed through the analysis of reagent blanks, near-detection-limit standards, and response factors. Potential field and/or laboratory contamination is assessed through use of trip blanks, method blanks, and equipment rinse blanks (also called “field blanks”). Field blanks for PFAS will be collected at a minimum frequency of one per day. A laboratory SOP for analysis of PFAS is included in Attachment 2.

Table 4 lists the requirements for field and laboratory QC samples that will be analyzed to assess data accuracy and precision, as well as to determine if equipment sensitivity has been compromised. Table 5 lists the number/type of field and QA/QC samples that will be collected during the RI. Table 6 lists the preservation, holding times and sample container information.

All RI “assessment” analyses (i.e., TCL plus 30/ TAL and TO-15) will be performed in accordance with the NYSDEC Analytical Services Protocol (ASP), using USEPA SW 846 methods.

All laboratory data are to be reported in NYSDEC ASP Category B deliverables and will be delivered to NYSDEC in electronic data deliverable (EDD) format as described on NYSDEC’s website (http://www.dec.ny.gov/chemical/62440.html). A Data Usability Summary Report (DUSR) will be prepared meeting the requirements in Section 2.2(a)1.ii and Appendix 2B of DER-10 for all data packages generated for the RI.

7. Site Control Procedures

Site control procedures, including decontamination and waste handling and disposal, are discussed below. Site control procedures have been developed to minimize both the risk of exposure to contamination and the spread of contamination during field activities at the Site. All personnel who come into designated work areas, including contractors and observers, will be required to adhere strictly to the conditions imposed herein and to the provisions of a Site-Specific Health and Safety Plan (HASP). The HASP is included as Appendix D to the RIWP.

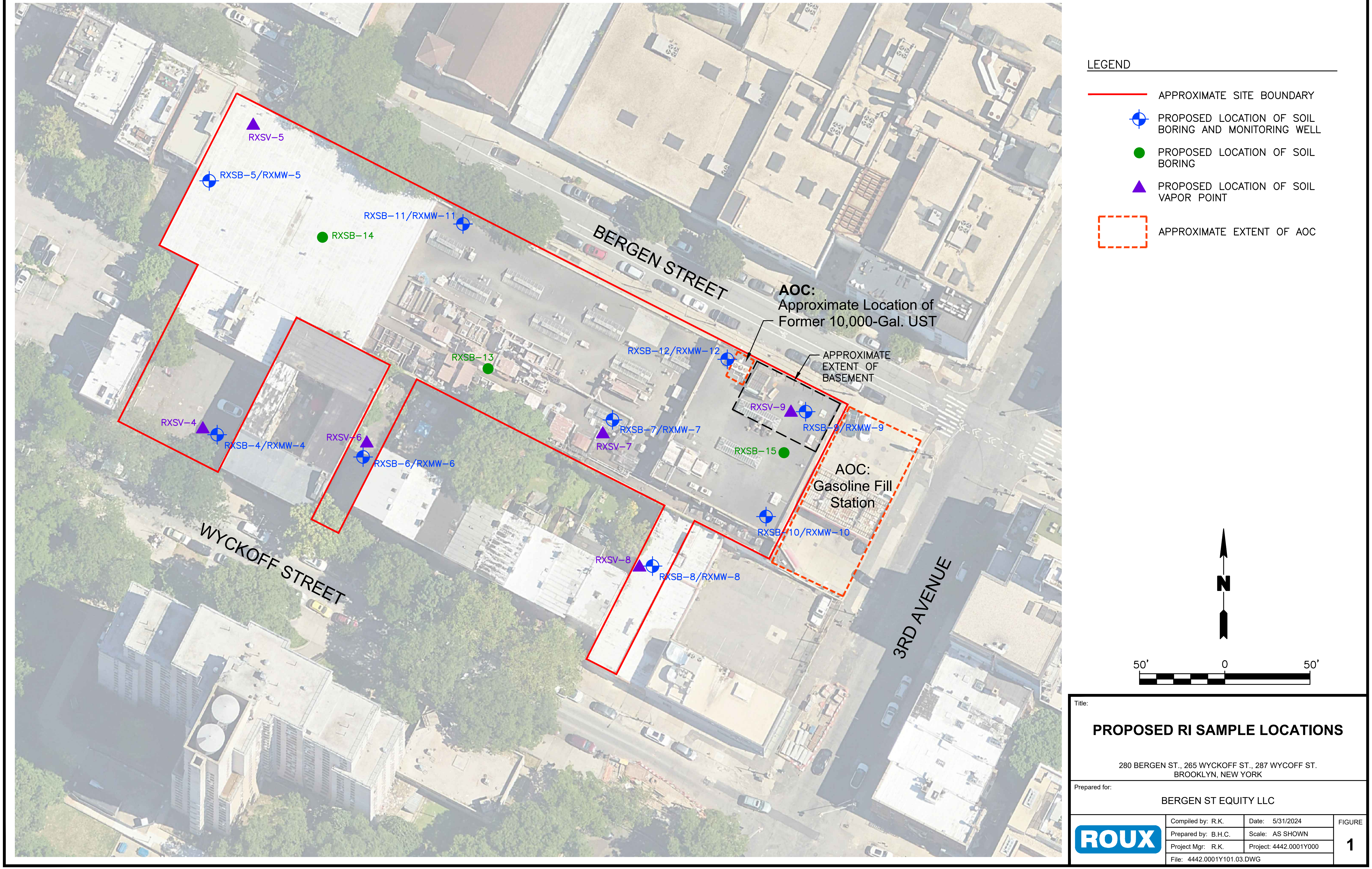
7.1 Decontamination

In an attempt to avoid the spread of contamination, all drilling and sampling equipment must be decontaminated at a reasonable frequency in a properly designed and located decontamination area. Detailed procedures for the decontamination of field and sampling equipment are included in Roux's SOPs for the Decontamination of Field Equipment located in Attachment 3. The location of the decontamination area will be determined prior to the start of field operations. The decontamination area will be constructed to ensure that all wash water generated during decontamination can be collected and containerized for proper disposal. As mentioned above, only Alconox or Liquinox will be used during decontamination procedures when groundwater sampling is underway.

7.2 Waste Handling and Disposal

All waste materials (drill cuttings, decontamination water, etc.) generated during the RI will be consolidated, and stored in appropriate labeled bulk containers (drums, etc.), and temporarily staged at an investigation derived waste storage area onsite. Roux will then coordinate waste characterization and disposal by appropriate means.

FIGURES



Title:

PROPOSED RI SAMPLE LOCATIONS

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 5/31/2024	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	1
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y101.03.DWG		

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TABLES

Table 1. Proposed Soil Sampling Locations

Location	Matrix	Sample Intervals	Parameters	Sampling Method	Rationale
Boring depth to the groundwater interface, approximately 18-20 ft bls.					
RXSB-4	Soil	0-2 ft bls; Interval directly below observed fill layer; Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	TCL + 30/TAL	SW-846 8260B;SW-846 8270C;SW-846 8081A; SW-846 8151A;SW-846 8082;SW-846 6010/7471; SW-846 7196A; SW-846 9012B	Evaluate soil conditions above the estimated water table; Evaluate shallow fill conditions; Evaluate conditions below fill layer; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions in the zone.
RXSB-6					
RXSB-8					
RXSB-10					
RXSB-12					
RXSB-14					
RXSB-7	Soil	Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	TCL + 30/TAL	SW-846 8260B;SW-846 8270C;SW-846 8081A; SW-846 8151A;SW-846 8082;SW-846 6010/7471; SW-846 7196A; SW-846 9012B	Evaluate soil conditions above the estimated water table; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions in the zone.
RXSB-5					
RXSB-9					
RXSB-11					
RXSB-13					
RXSB-15					
RXSB-4	Soil	0-2 ft bls; Interval directly below observed fill layer; Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	1,4-Dioxane, PFAS	Method 1633 Modified; SW-846 8270D**	Evaluate soil conditions above the estimated water table; Evaluate shallow fill conditions; Evaluate conditions below fill layer; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions in the zone.
RXSB-6					
RXSB-8					
RXSB-10					
RXSB-12					
RXSB-14					
RXSB-7	Soil	Most impacted two-foot interval (if applicable); Interval below most impacted interval (if applicable); If no impacts are observed, interval directly above observed groundwater table.	1,4-Dioxane, PFAS	Method 1633 Modified; SW-846 8270D**	Evaluate soil conditions above the estimated water table; Evaluate potential impacts in soil (if applicable); Evaluate conditions below observed impacts (if applicable); Evaluate soil conditions in the zone.
RXSB-5					
RXSB-9					
RXSB-11					
RXSB-13					
RXSB-15					

Sample Interval depths are in feet below land surface; Additional intervals may be added based on field observations
**Laboratory will report to their minimum possible standards for each method (QAPP Table 7)
TCL + 30/TAL - includes TCL VOCs + 10 TICs, TCL BNA (SVOCs) + 20 TICs, TCL Pest/Herb/PCBs, TAL Metals
AOC - Area of Concern
TCL - USEPA Contract Laboratory Program Target Compound List
BNA - Base Neutral Acids
TAL - USEPA Contract Laboratory Program Target Analyte List
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls
TICs - Tentatively Identified Compounds
PFAS - Per- and Polyfluoroalkyl Substances
QA/QC samples will be collected as described in the QAPP (Appendix C)
QAPP - Quality Assurance Project Plan

Table 2. Proposed Groundwater Sampling Locations

Location	Matrix	Sample Interval	Sample Parameters	Sampling Method**	Rationale
RXMW-4	Groundwater	Water Table[1]	TCL + 30/TAL	SW-846 8260B;SW-846 8270C;SW-846 8081A; SW-846 8151A;SW-846 8082;SW-846 6010/7471; SW-846 7196A; SW-846 9012B	To evaluate potential impacts to groundwater quality as a result of historical on-Site and off-Site uses.
RXMW-5					
RXMW-6					
RXMW-7					
RXMW-8					
RXMW-9					
RXMW-10					
RXMW-11					
RXMW-12					
RXMW-4	Groundwater	Water Table[1]	1,4-Dioxane, PFAS	SW-846 8270D; EPA 1633	To evaluate potential emerging contamiannt impacts to groundwater quality as a result of historical on-Site and off-Site uses.
RXMW-5					
RXMW-6					
RXMW-7					
RXMW-8					
RXMW-9					
RXMW-10					
RXMW-11					
RXMW-12					

** Laboratory will report to their minimum possible standards for each method (QAPP Table 7)

TCL + 30/TAL - includes TCL VOCs + 10 TICs, TCL BNA (SVOCs) + 20 TICs, TCL Pest/PCBs, TAL Metals, Hexavalent Chromium

TCL - USEPA Contract Laboratory Program Target Compound List

TAL - USEPA Contract Laboratory Program Target Analyte List

VOCs - Volatile Organic Compounds

SVOCs - Semivolatile Organic Compounds

TICs - Tentatively Identified Compounds

PCBs - Polychlorinated Biphenyls

PFAS - Per- and Polyfluoroalkyl Substances

QA/QC samples will be collected as described in the QAPP (Appendix C)

*All groundwater samples will be analyzed for both filtered and unfiltered metals and SVOCs

Table 3. Proposed Soil Vapor Sampling Locations

Location	Matrix	Sample Depth/Location	Sample Parameters	Sampling Method**	Rationale
RXSV-4	Soil Vapor	Soil vapor points to be installed approximately 5 feet below ground surface.	VOCs	TO-15	To evaluate the nature and extent of soil vapor impacts throughout the Site as a result of on-Site and off-Site historical uses.
RXSV-5					
RXSV-6					
RXSV-7					
RXSV-8					
RXSV-9					

** Laboratory will report to their minimum possible standards for each method (QAPP Table 7)
VOCs - Volatile Organic Compounds
QA/QC samples will be collected as described in the QAPP (Appendix C)

Table 4. Field and Laboratory QC Summary

QC Check Type	Minimum Frequency	Use
Field QC		
Duplicate	1 per matrix per 20 samples or SDG	Precision
Trip Blank	1 per VOC cooler	Sensitivity
Field Blank	1 per matrix per 20 samples, 1 per day when sampling for PFAS	Sensitivity
Equipment Blank	1 per day when sampling for PFAS	Sensitivity
Laboratory QC		
Laboratory Control Sample	1 per matrix per SDG	Accuracy
Matrix Spike/Matrix Spike Duplicate/Matrix Duplica	1 per matrix per SDG	Accuracy/Precision
Surrogate Spike	All organics samples	Accuracy
Laboratory Duplicate	1 per matrix per SDG	Precision
Method Blank	1 per matrix per SDG	Sensitivity

* SDG - Sample Delivery Group - Assumes a single extraction or preparation

** Provided to lab by field sampling personnel

PFAS - Per- and Polyfluoroalkyl Substances

Table 5. Remedial Investigation Sampling Summary

Sample Medium	Target Analytes	Field Samples	Replicates[1]	Trip Blanks[2]	Field Blanks[3]	Equipment Blanks[3]	Matrix Spikes[1]	Spike Duplicates[1]	Total No. of Samples
Soil	TCL VOCs +10	22	2	4	2	-	2	2	34
	TCL VOCs	22	2	4	2	-	2	2	34
	TCL SVOCs +20	22	2	-	2	-	2	2	30
	TCL SVOCs	22	2	-	2	-	2	2	30
	TCL Pesticides	22	2	-	2	-	2	2	30
	TCL Herbicides	22	2	-	2	-	2	2	30
	TCL PCBs	22	2	-	2	-	2	2	30
	TAL Metals	22	2	-	2	-	2	2	30
	Total Cyanide	22	2	-	2	-	2	2	30
	PFAS	22	2	-	8	-	2	2	36
	1,4-Dioxane	22	2	-	2	-	2	2	30
	Total Cyanide	22	2	-	2	-	2	2	30
	Hexavalent Chromiu	22	2	-	2	-	2	2	30
Groundwater	TCL VOCs +10	7	1	-	1	-	1	1	11
	TCL SVOCs +20	7	1		1	-	1	1	11
	TCL Pesticides	7	1	-	1	-	1	1	11
	TCL Herbicides	7	1	-	1	-	1	1	11
	TCL PCBs	7	1	-	1	-	1	1	11
	TAL Metals*	7	1	-	1	-	1	1	11
	PFAS	7	1	-	2	1	1	1	13
	1,4-Dioxane	7	1	-	1	-	1	1	11
	Total Cyanide	7	1	-	1	-	1	1	11
	Hexavalent Chromiu	7	1	-	1	-	1	1	11
	TO-15 VOCs	4	1	-	1	-	1	1	8

Totals are estimated based on scope of work as written, actual sample quantities may vary based on field conditions. QA/QC sample quantities will b

[1] Based on 1 per 20 samples or 1 per Sample Delivery Group (3 days max)

[2] Based on 1 cooler per day

[3] Based on 1 per day PFAS sampling occurs

TCL - USEPA Contract Laboratory Program Target Compound List
USEPA - United States Environmental Protection Agency
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls
EPH - Extractable Petroleum Hydrocarbons
RCRA - Resource Conservation and Recovery Act
TCLP - Toxicity Characteristic Leaching Procedure
PFAS - Per- and Polyfluoroalkyl Substances
TAL - USEPA Contract Laboratory Program Target Analyte List
*All groundwater samples will be analyzed for both filtered and unfiltered metals.

Table 5. Remedial Investigation Sampling Summary

e adjusted a

Table 6. Preservation, Holding Times and Sample Containers

Analysis	Matrix	Bottle Type	Preservation(a)	Holding Time(b)
TAL Metals (total & dissolved)	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	180 days, Hg 28 days
SW-846 6020B/7471B	Water	250 mL plastic, teflon lined cap	Nitric acid	
Hexavalent Chromium\Trivalent Chromium(calculatec	Soil	2 oz wide mouth glass, teflon lined cap	None	180 days
SW-846 7196A\6010C	Water	500 mL Plastic		24 hours from sample collection
Total Cyanide	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days from sample collection
SW-846 9012B	Water	250 mL Plastic	NaOH	14 days from sample collection
1,4-Dioxane	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days from sample collection
SW-846 8270D GS/MS SIM/Isotope Dilution	Water	2 x 500 mL amber wide mouth glass	Cool to 4°C	7 days from sample collection
Per- and Polyfluoroalkyl Substances (PFAS)	Soil	8 oz HDPE plastic container (non teflon lined)	Cool to 4°C	28 days from sample collection
EPA Method 1633	Water	2 - 250 mL HDPE plastic	Trizma	14 days from sample collection
Volatile Organic Compounds (VOCs)	Air	6 liter Summa Canister for 2-hr sampling period	None	14 days from sample collection
TO-15	Air	1 liter Summa Canister for 2-hr sampling period	None	14 days from sample collection
Target Compound List (TCL)				
TCL Volatile Organic Compounds (VOCs) + 10 TICS	Soil	Encore	Cool to 4°C	24 hours from sample collection
SW-846 8260C	Water	40mL voa vial, teflon lined cap	Hydrochloric Acid	14 days from sample collection
TCL Semivolatile Organic Compounds (SVOCs) +20	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
SW-846 8270D	Water	1 liter amber glass, teflon lined cap		7 days to extract, 40 days to analysis
TCL Pesticides	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
SW-846 8081B	Water	1 liter amber glass, teflon lined cap		7 days to extract, 40 days to analysis
TCL Herbicides	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
SW-846 8151A	Water	1 liter amber glass, teflon lined cap		7 days to extract, 40 days to analysis
TCL Polychlorinated biphenyls (PCBs)	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
SW-846 8082A	Water	1 liter amber glass, teflon lined cap		7 days to extract, 40 days to analysis

[a] All soil and groundwater samples to be preserved in ice during collection and transport

[b] Days from date of sample collection.

TAL - Target Analyte List

TCL - USEPA Contract Laboratory Program Target Compound List

Gas chromatography-mass spectrometry (GC/MS) in selected ion monitoring (SIM) mode

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1633	1633_Shake	Perfluorobutanoic acid (PFBA)	375-22-4	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1634	1633_Shake	Perfluoropentanoic acid (PFPeA)	2706-90-3	0.400	0.100
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1635	1633_Shake	Perfluorohexanoic acid (PFHxA)	307-24-4	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1636	1633_Shake	Perfluoroheptanoic acid (PFHpA)	375-85-9	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1637	1633_Shake	Perfluorooctanoic acid (PFOA)	335-67-1	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1638	1633_Shake	Perfluorononanoic acid (PFNA)	375-95-1	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1639	1633_Shake	Perfluorodecanoic acid (PFDA)	335-76-2	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1640	1633_Shake	Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1641	1633_Shake	Perfluorododecanoic acid (PFDoA)	307-55-1	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1642	1633_Shake	Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1643	1633_Shake	Perfluorotetradecanoic acid (PFTeDA)	376-06-7	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1644	1633_Shake	Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1645	1633_Shake	Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	0.200	0.0500

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1646	1633_Shake	Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1647	1633_Shake	Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1648	1633_Shake	Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1649	1633_Shake	Perfluorononanesulfonic acid (PFNS)	68259-12-1	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1650	1633_Shake	Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1651	1633_Shake	1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS)	757124-72-4	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1652	1633_Shake	1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1653	1633_Shake	1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1654	1633_Shake	Perfluorooctanesulfonamide (PFOSA)	754-91-6	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1655	1633_Shake	N-methylperfluorooctane sulfonamide (NMeFOSA)	31506-32-8	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1656	1633_Shake	N-ethylperfluorooctane sulfonamide (NEtFOSA)	4151-50-2	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1657	1633_Shake	N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1658	1633_Shake	N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	0.200	0.0500

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1659	1633_Shake	N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)	24448-09-7	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1660	1633_Shake	N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)	1691-99-2	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1661	1633_Shake	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	13252-13-6	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1662	1633_Shake	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1663	1633_Shake	Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	0.400	0.100
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1664	1633_Shake	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	0.400	0.100
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1665	1633_Shake	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1666	1633_Shake	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	0.800	0.200
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1667	1633_Shake	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	0.400	0.100
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1668	1633_Shake	3-Perfluoropropylpropanoic acid (3:3 FTCA)	356-02-5	1.00	0.250
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1669	1633_Shake	3-Perfluoropentylpropanoic acid (5:3 FTCA)	914637-49-3	5.00	1.25
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1670	1633_Shake	3-Perfluoroheptylpropanoic acid (7:3 FTCA)	812-70-4	5.00	1.25
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1701	1633_Shake	Perfluorodecanesulfonic acid (PFDS)	335-77-3	0.200	0.0500

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)	1702	1633_Shake	Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	0.400	0.100
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1704	1633_Shake	Perfluorobutanoic acid (PFBA)	375-22-4	8.00	2.13
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1705	1633_Shake	Perfluoropentanoic acid (PFPeA)	2706-90-3	4.00	1.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1706	1633_Shake	Perfluorohexanoic acid (PFHxA)	307-24-4	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1707	1633_Shake	Perfluoroheptanoic acid (PFHpA)	375-85-9	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1708	1633_Shake	Perfluorooctanoic acid (PFOA)	335-67-1	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1709	1633_Shake	Perfluorononanoic acid (PFNA)	375-95-1	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1710	1633_Shake	Perfluorodecanoic acid (PFDA)	335-76-2	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1711	1633_Shake	Perfluoroundecanoic acid (PFUnA)	2058-94-8	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1712	1633_Shake	Perfluorododecanoic acid (PFDoA)	307-55-1	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1713	1633_Shake	Perfluorotridecanoic acid (PFTrDA)	72629-94-8	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1714	1633_Shake	Perfluorotetradecanoic acid (PFTeDA)	376-06-7	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1715	1633_Shake	Perfluorobutanesulfonic acid (PFBS)	375-73-5	2.00	0.500

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1716	1633_Shake	Perfluoropentanesulfonic acid (PFPeS)	2706-91-4	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1717	1633_Shake	Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2.00	0.517

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1718	1633_Shake	Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1719	1633_Shake	Perfluorooctanesulfonic acid (PFOS)	1763-23-1	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1720	1633_Shake	Perfluorononanesulfonic acid (PFNS)	68259-12-1	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1721	1633_Shake	Perfluorododecanesulfonic acid (PFDoS)	79780-39-5	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1722	1633_Shake	1H,1H,2H,2H-Perfluorohexane sulfonic acid (4:2 FTS)	757124-72-4	8.00	2.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1723	1633_Shake	1H,1H,2H,2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	8.00	2.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1724	1633_Shake	1H,1H,2H,2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	8.00	2.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1725	1633_Shake	Perfluorooctanesulfonamide (PFOSA)	754-91-6	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1726	1633_Shake	N-methylperfluorooctane sulfonamide (NMeFOSA)	31506-32-8	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1727	1633_Shake	N-ethylperfluorooctane sulfonamide (NEtFOSA)	4151-50-2	2.00	0.500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1728	1633_Shake	N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	2.00	0.620
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1729	1633_Shake	N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	2.00	0.521
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1730	1633_Shake	N-methylperfluorooctane sulfonamidoethanol (NMeFOSE)	24448-09-7	20.0	5.00

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1731	1633_Shake	N-ethylperfluorooctane sulfonamidoethanol (NEtFOSE)	1691-99-2	20.0	5.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1732	1633_Shake	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	13252-13-6	8.00	2.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1733	1633_Shake	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	919005-14-4	8.00	2.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1734	1633_Shake	Perfluoro-4-methoxybutanoic acid (PFMBA)	863090-89-5	4.00	1.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1735	1633_Shake	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	151772-58-6	4.00	1.22
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1736	1633_Shake	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	756426-58-1	8.00	2.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1737	1633_Shake	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	763051-92-9	8.00	2.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1738	1633_Shake	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)	113507-82-7	4.00	1.00
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1739	1633_Shake	3-Perfluoropropylpropanoic acid (3:3 FTCA)	356-02-5	10.0	2.50
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1740	1633_Shake	3-Perfluoropentylpropanoic acid (5:3 FTCA)	914637-49-3	50.0	12.5
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1741	1633_Shake	3-Perfluoroheptylpropanoic acid (7:3 FTCA)	812-70-4	50.0	14.9
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1772	1633_Shake	Perfluorodecanesulfonic acid (PFDS)	335-77-3	0.200	0.0500
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)	1773	1633_Shake	Perfluoro-3-methoxypropanoic acid (PFMPA)	377-73-1	0.400	0.100
Semivolatile Organic Compounds (GC/MS) (SOLID)	8270E	3546	1,4-Dioxane	123-91-1	0.0330	0.0289

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL
Semivolatile Organic Compounds (GC/MS SIM / Isotope Dilution) (AQUEOUS)	8270E_SIM_MS_ID	3510C_LVI	1,4-Dioxane	123-91-1	0.200	0.0720

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Per- and Polyfluoroalkyl Substances by LC/MS/MS (SOLID)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	58	148		58	148	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	54	152		54	152	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	55	152		55	152	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	54	154		54	154	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	52	161		52	161	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	59	149		59	149	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	52	147		52	147	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	48	159		48	159	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	64	142		64	142	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	49	148		49	148	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	47	161		47	161	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	62	144		62	144	30		

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	59	151		59	151	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	57	146		57	146	30		

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	55	152		55	152	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	58	149		58	149	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	52	148		52	148	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	36	145		36	145	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	67	146		67	146	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	61	151		61	151	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	63	152		63	152	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	61	148		61	148	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	63	145		63	145	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	65	139		65	139	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	58	144		58	144	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	59	146		59	146	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	71	136		71	136	30		

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	69	137		69	137	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	63	144		63	144	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	68	146		68	146	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	55	148		55	148	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	48	161		48	161	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	56	156		56	156	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	46	156		46	156	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	56	151		56	151	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	62	129		62	129	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	63	134		63	134	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ng/L	50	138		50	138	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ug/Kg	40	150	30	40	150	30		
Per- and Polyfluoroalkyl Substances by LC/MS/MS (AQUEOUS)		ug/Kg	40	150	30	40	150	30		
Semivolatile Organic Compounds (GC/MS) (SOLID)		mg/Kg	30	120	30	30	120	30		

Table 7. PFAS 1633 and 1,4-Dioxane Limits

Method Description	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Semivolatile Organic Compounds (GC/MS SIM / Isotope Dilution) (AQUEOUS)		ug/L	50	142	20	50	142	20		

ATTACHMENTS

1. Professional Profiles
2. Laboratory's Standard Operating Procedures
3. Roux's Standard Operating Procedures
4. NYSDEC PFAS Sampling Guidance

ATTACHMENT 1

Professional Profiles

PROFESSIONAL PROFILE

Robert Kovacs, LSRP, PG

Principal Scientist

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EDUCATION

BA, Biological Sciences, University of Delaware, Newark, Delaware, 1999.

PROFESSIONAL LICENSES

Licensed Site Remediation Professional, New Jersey (License No. 627589)

New York State Professional Geologist (License No.000437)

NJDEP UST Certification Program-Subsurface Evaluator (License No. 239024)

EXPERIENCE SUMMARY

Twenty-three years of experience: Principal, Senior, Project, Staff and Staff Assistant Environmental Scientist at Roux, Islandia, New York.

TECHNICAL SPECIALTIES

Design, implementation and management of Environmental Site Assessments, Remedial Investigations, Remedial Actions, and Construction Support at Transportation, Industrial, and Brownfield Redevelopment sites; Development of regulatory strategy and regulatory agency negotiations; Characterization and decommissioning of industrial manufacturing facilities; Roux Corporate QA/QC Officer.

REPRESENTATIVE PROJECTS

- **Amtrak Sunnyside Yard State Superfund Site, Queens, New York.** Principal-in-Charge for multiple projects to support investigation and remediation activities at this State Superfund site. Mr. Kovacs was responsible for overseeing activities in all six Operable Units (OUs), including unsaturated and saturated soil, groundwater, separate-phase hydrocarbon, soil vapor and on-site sewer system. His responsibilities on these projects included PFAS investigations; UST removals; characterizing subsurface conditions, including soil (collected hundreds of soil samples to characterize the 130+ acre active railyard), as well as characterizing a 250,000-gallon PCB-contaminated separate-phase hydrocarbon plume. Additionally, he was responsible for overseeing the design and implementation of remediation activities, including soil excavation and offsite disposal, removal and abandonment of USTs ranging in sizes up to 17,000 gallons, demolition of contaminated buildings and infrastructure, and installation and operation of a dual phase high vacuum extraction (DPVE) system to recover PCB-contaminated separate-phase hydrocarbon through a network of over 40 recovery wells. Due to the highly volatile nature of the separate-phase hydrocarbon and the urban setting of this site, extensive emissions and odor engineering controls were used when excavating and managing soil and product. Additionally, extensive Community Air Monitoring was completed during all phases of work. Mr. Kovacs was also responsible for interaction with all regulatory agencies, as well as preparing and/or reviewing all major project reports and deliverables.

- **Amtrak Infrastructure Construction Projects.** Principal-in-Charge of several large infrastructure upgrade projects for Amtrak, including the Next Generation Acela Ready Track project, the Sunnyside Yard Security Enhancement project, the Sunnyside Yard Water Main Upgrade project, and the initial stages of the Intercity Trainset (ICT) project. Mr. Kovacs is serving as Project Principal, and involved in the planning, site characterization (including PFAS evaluations), construction oversight, and regulatory agency coordination associated with these projects.

- **Pharmaceutical Manufacturing Facility, Brooklyn, New York.** Project Manager/Project Principal for environmental work associated with the seven-block former manufacturing plant. This Site included a former 700,000 square foot manufacturing plant, as well as several other former industrial facilities with operations starting as far back as the 1850's. Responsibilities included UST removals; the design and completion of multiple phases of subsurface investigations to characterize soil and groundwater quality, as well as soil vapor. Contaminants included hydrocarbons, benzene, PCBs, and heavy metals, including lead, mercury, and arsenic. Work included development and preparation of investigation and remediation work plans, coordination and management of field investigations, including the installation of shallow and deep monitoring wells and soil borings using sonic drilling methods, completion of a geophysical survey, collection of groundwater samples, and management of remediation activities. Remediation activities included soil excavation, UST removals, and the installation of a soil vapor extraction and air sparging system. Work was completed under several different regulatory agencies, including NYSDEC and NYCOER. Also provided presentations to school authorities, including the NYC DOE, to communicate the progress of the project and to educate administrators regarding the Site's environmental issues.

- **Lendlease Java Street Waterfront Redevelopment – Greenpoint, New York.** Principal-in-Charge for this large redevelopment project located on the waterfront in Greenpoint, New York. This 2.6-acre site is being redeveloped into a mixed-use development, including a residential tower, retail space, and a shoreline esplanade with NYC Ferry terminal access. This project incorporates many green and sustainability initiatives in its design. Work on this project has included due diligence support, involving the completion of a Phase I and Phase II ESA, NYSDEC BCP application, preparation of a Remedial Investigation Report and Remedial Action Work Plan, as well as supporting Lendlease in negotiation with NYSDEC to maximize site preparation and tangible tax credits. Work also included implementing an extensive In-situ Waste Characterization program, including PFAS investigation, negotiating soil reuse, and developing and implementing a complex remedial design program and community air monitoring program. The remedy for the site included design of a Sub-Slab Depressurization System (SSDS) to mitigate vapors beneath the future building, as well as negotiation with NYSDEC and NYCOER to ensure 421a schedule requirements were achieved. As part of this work, soil borings, monitoring wells, piezometers, and soil vapor monitoring points were installed, and hydrogeologic cross sections were prepared. Additionally, as part of this project, the tidal influence of the East River on site groundwater was studied, and a benthic sediment investigation was conducted in the East River.
- **Industrial Warehouse Development – Bayshore, New York.** Principal-in-Charge for a proposed industrial warehouse development located in Bayshore, Long Island, NY. As part of the project an initial Phase II investigation and PFAS evaluation was completed at this industrial site that contains a large former landfill. A BCP Application was prepared and is currently under review by NYSDEC.
- **Affordable Housing Development – Bronx, New York.** Principal- in-Charge for the redevelopment of a former US Postal Service Fleet Maintenance facility located in the south Bronx. This site will be redeveloped into a 100% affordable housing complex. I was retained to complete all initial due diligence activities, including PFAS investigation, and to evaluate possible NYSDEC BCP eligibility. Once determined the site is a good candidate for the BCP, we prepared a BCP Application, and all required reporting. We also ensured that the site met 421a schedule requirements throughout the development and implementation of an Interim Remedial Measures (IRM) Plan. Full scale remediation is currently underway, including the remediation of hazardous soils, removal of USTs, and removal of multiple hydraulic lifts. Responsibilities also included design of a Sub-Slab Depressurization System (SSDS) to mitigate vapors beneath the future building.
- **Chlorinated Solvent Remediation – Parsippany-Troy Hills, New Jersey.** Principal-in-Charge for the Remedial Investigation and Remedial Action implementation associated with a former dry cleaner release located in Parsippany-Troy Hills, New Jersey. We were retained by one of the largest real estate developers in the United States to complete this project. Soil, groundwater, and subsurface vapor were impacted with chlorinated VOCs as a result of the former dry cleaner operations. Responsibilities included the design and management of a Supplemental RI that included the installation of soil borings, monitoring wells and the completion of groundwater vertical profiling. Additionally, Mr. Kovacs was responsible for the design, implementation, and management of an extensive groundwater remediation injection program in which approximately 200,000 pounds of Zero-Valent Iron (ZVI) and 2,500 gallons of Emulsified Vegetable Oil (EVO) were injected into the subsurface using pneumatic fracturing. Initial post-treatment results show over 95 percent reduction in concentrations of chlorinated VOCs in groundwater. Furthermore, he was responsible for the design, installation, and operation of a SVE system to address impacted vadose zone soil.
- **Brookfield Hudson Exchange West – Jersey City, New Jersey.** Principal-in-Charge and LSRP for the first three towers as part of this mixed-income development near the Jersey City waterfront. Overall, this project will include 11 residential towers. To date, two towers are completed, and one is about to begin construction. I am LSRP of record for: Phase 1A (625,000 square foot, 35-story tower), Phase 1B (432 unit, 35-story tower), and Phase 2 (60-story tower, with 802 Units and ShopRite supermarket planned for the second floor). Responsibilities included all initial site investigation, remedial design, and remedial implementation. Additionally, I was responsible for all compliance with NJDEP requirements, including preparation and certification of all reports, preparation of Remedial Action Permits, issuance of RAOs, and implementation of all post remedial activities and reporting.

- **Residential/Commercial Redevelopment – Brooklyn, New York.** Principal-in-Charge for a mixed-use development located in Red Hook, NY. Completed Phase II investigation and designed and implemented several Interim Remedial Measures. Also advised client on the most advantageous regulatory pathway to implement the redevelopment project. We are currently in the process of submitting a BCP Application to NYSDEC.

- **Chlorinated Solvent Release – Bernardsville, New Jersey.** Principal-in-Charge for the investigation of an extensive chlorinated solvent plume emanating from a former dry cleaner site. Contamination from this site has migrated far off site in groundwater, and has potentially impacted nearby surface water. Work includes installation of soil borings and monitoring wells to characterize contamination in soil, perched water, groundwater in the deep unconsolidated aquifer zone, as well as groundwater in the weathered bedrock matrix and bedrock matrix. Further, contamination from the Site is co-mingled with contamination from other solvent release sites, complicating NJDEP negotiations and investigation/remedial requirements. Mr. Kovacs serves as the LSRP of record for this project.

- **UST Spill Site – Brooklyn, New York.** Principal-in-Charge for the investigation of a Spill in Williamsburg, Brooklyn, New York. M. Kovacs lead the project team in successfully demonstrating to NYSDEC's Spills Group that impacts to a deep groundwater zone beneath the client's site were a result of offsite contamination migrating onsite from a nearby active gasoline station (not a result of the client's former industrial operations). Impacts included the presence of several feet of free-product in a deep groundwater zone. Furthermore, he was successful in getting the client's Spill Case closed, saving the client from additional investigation activities, and what will likely be a multi-million-dollar remediation to address free-product beneath a semi- confining clay zone.

- **Former Vehicle Maintenance Facility – Parlin, New Jersey.** Project Manager for the removal of (2) waste oil USTs, a subsurface oil water separator, piping, and remediation of associated petroleum contaminated soil at a former vehicle maintenance facility in Parlin, New Jersey. Roux was retained by one of the largest real estate developers in the United States to complete this project. This remediation was completed to allow for a new, national tenant to occupy this retail space. As part of this work, it was determined that a historic release occurred from the OWS, triggering a RI for petroleum-related VOCs and chlorinated VOCs in soil. Mr. Kovacs was also responsible for the development and implementation of the Remedial Action for the Site, which included excavation and off-site soil disposal. SESOIL modeling was also utilized to demonstrate groundwater (approximately 100 feet deep) was not impacted by the shallow soil contamination. As part of this project, he took a lead role in preparing the SI Report, RI Report, RAW, RAR, Receptor Evaluation, and the Unrestricted Use RAO.

- **NJ Transit Active Bus Facility, New Jersey.** Project Principal for the completion of a RI at an active bus garage located in Fairview, New Jersey for a major transit agency. Responsibilities included the delineation of a free-product plume, characterization of soil and groundwater quality, report preparation, and correspondence with the NJDEP. Moreover, Mr. Kovacs was responsible for implementing free-product Interim Remedial Measure efforts. Currently, he is finalizing the RI report for the Site, and managing the Remedial Action design, and supporting the LSRP in meeting all NJDEP administrative requirements.

- **Residential Hi-Rise Development – Manhattan, New York.** Principal-in-Charge for a redevelopment site in mid-town Manhattan working for a private developer who is building a mixed-use retail/commercial tower. Work included a Phase I ESA and Phase II ESA. As part of the Phase II shallow bedrock was identified in portions of the site, and an LNAPL plume was identified in the overburden soils. Responsibilities included bedrock evaluation, LNAPL recovery utilizing multiple different techniques. Responsibilities also included construction support, health and safety support, management of all soil excavated and transported off site, and the design of a Sub-Slab Depressurization System (SSDS) to mitigate vapors in the vadose zone beneath the new building structure that were emanating from groundwater.

- **Ship Dry Dock Facility – Hoboken, New Jersey.** Project Manager for the completion of a Preliminary Assessment and Site Investigation (PA/SI) at an active ship dry dock facility in Hoboken, New Jersey. Responsible for the coordination and management of field investigation activities, which included soil, groundwater, and sediment sampling, as well as the preparation of a PA and SI report. This work was completed on behalf of a potential buyer of the property who planned to redevelop this site into a New York City ferry terminal.

- **BICC Cables – Yonkers, New York.** Project Manager for the investigation and remediation of the interior and subsurface soils of a former cable manufacturing facility located in Yonkers, New York to be redeveloped into a movie studio. Responsibilities included the completion of several large-scale investigations, including the collection of wipe, soil and building material samples to characterize PCB and lead impacts at this 200,000+ square foot facility Additional tasks included oversight of the remediation of interior surfaces using several different methods for the removal of PCBs and lead, and remediation of a sub-surface drainage trench and process water system. Further work included the preparation of a

Remedial Investigation report and a Feasibility Study report for submittal to the NYSDEC.

- **Amtrak Electrical Substation – Rahway, New Jersey.** Project Manager for the RI and RA design and implementation at an active electrical substation in Rahway, New Jersey for a national passenger railroad agency. Responsibilities included completing an RI to delineate PCBs in soil, and the management of free- product recovery programs. Further, Mr. Kovacs was responsible for managing the RA at the Site, which included soil excavation and offsite disposal, and free- product recovery. As part of this project, he supported the Site LSRP and took a lead role in preparing the Supplemental RI Report, RAW, RAR, Receptor Evaluation, and the Unrestricted Use RAO. Additionally, he assisted the LSRP in satisfying all NJDEP administrative requirements, including preparation of forms, public notifications, and submittal of fees.

- **Echo Bay Redevelopment – New Rochelle, New York.** Project Manager for the completion of Phase I and Phase II Environmental Site Assessment activities associated with a proposed mixed-use redevelopment located in Westchester, New York. Work included management of subsurface investigation activities to characterize soil conditions, and working closely with client's architects and construction contractors to integrate the proposed site remediation into the project development plan (including evaluating multiple potential disposal scenarios). Site contaminants included hydrocarbons (including free-product plume from former USTs), and historic fill constituents.

- **Former Dry Cleaner – Ramsey, New Jersey.** Project manager for the SI, RI, and vapor intrusion investigation at a former dry cleaner in Ramsey, New Jersey. Responsibilities included managing and coordinating field investigations, preparing remedial cost estimates for redevelopment, and preparation of reports and satisfying NJDEP Administration requirements. This work is being done to support redevelopment of the Site for a large, national fitness center tenant.

- **Former Service Station – Patterson, New Jersey.** Project Manager for the implementation of a groundwater remediation injection program to address petroleum contamination at a former service station located in Paterson, New Jersey for a major transit agency. Responsibilities included implementation of a PA and SI to further investigate chlorinated VOCs at this Site. As part of this project, Mr. Kovacs took a lead role in preparing reports and the Permit-by-Rule Request, as well as assisting in satisfying all NJDEP administrative requirements.

- **NJ Transit Active Railyard – Roxbury Township, New Jersey.** Project manager for the investigation of a diesel release at an active railyard in. This release was caused by a faulty underground pipe located in the locomotive fueling area. The diesel release resulted in a free-product plume, groundwater impacts, and impacts to a subsurface drainage culvert and a nearby lake. Responsibilities included the development and coordination of a field investigation program, coordination of routine gauging and free-product recovery events, correspondence with NJDEP, and preparation of a baseline ecological evaluation. Additionally, Mr. Kovacs supported the Site LSRP in meeting all NJDEP administrative requirements.

Facility Demolition/Decommissioning

- **Former Pharmaceutical Manufacturing Facility Decommissioning, Brooklyn, New York.** Project Manager for the interior decontamination and decommissioning of a 700,000+ square foot former manufacturing facility located in Brooklyn, New York to allow for redevelopment of the building for commercial, retail, and light industrial use, and use as a movie studio, and for local food businesses. This redevelopment has earned significant positive press, as it is considered a highly beneficial reuse for the community. This project included the development of decontamination and decommissioning work plan, technical support of bidding process, and full time onsite engineering support of the entire project.

  Decontamination and decommissioning activities included removal/cleaning of hundreds of air handling units and dust collector units impacted with manufacturing dusts and residues, as well as thousands of feet of intricate vacuum, ventilation, and dust collection lines. This project also included the removal of concrete impacted with metals, PCBs, and/or VOCs, selective interior demolition, and decontamination of former laboratory, milling, compounding, blending, and packaging areas, as well as asbestos abatement. At the conclusion of this project, a Final Report was prepared, documenting in detail the extensive work completed and that the work plan objectives were achieved.

- **Former Pharmaceutical Manufacturing Facility Demolition, Brooklyn, New York.** Project Manager for the demolition of two former manufacturing buildings in Brooklyn, New York. Both buildings were impacted with hazardous levels of PCBs, mercury, and lead. Responsibilities included in situ waste characterization of building materials, oversight of hazardous waste removal, completion of waste manifests, and full-time Community Air Monitoring during all demolition activities. Additionally, Roux Associates performed daily inspections and monitoring to ensure the protection of a nearby elementary school and prepared a completion report at the conclusion of the project.

- **PCB Building Material Remediation.** Principal-in-Charge for the investigation and TSCA remediation of PCB containing paint in a former manufacturing area. This location (approximately

2,000 square feet in area, and two stories in height) was found to contain PCBs in the paint matrix at concentrations as high as 10,000 parts per million. The underlying building material (brick, concrete, and terra cotta) was also found to be impacted with PCBs from the paint. Responsibilities included preparation of a Self-Implementing Notification and Alternative Decontamination Methods and Verification Sampling Work Plan to remediate the PCBs under the TSCA regulatory framework. This project also included providing field oversight of the PCB remediation, completion of the extensive verification sampling program of the underlying porous building material, and collection of confirmation air samples and confirmation wipe samples outside of the exclusion zone to confirm proper function of all critical barriers. Following the successful completion of the project, a Final Report was prepared and submitted to USEPA documenting the entire project in detail.

Expert/Insurance Litigation Support

- Consulting Fact Witness for an insurance litigation claim where insured was seeking to be reimbursed for more than $15 million of previous environmental investigation/remediation costs. Mr. Kovacs responsibilities included a formal deposition and testifying in US District Federal Court – Eastern District of New York. Case resulted in favorable ruling for our client.
- Consulting expert for a PRP to the Gowanus Canal Superfund Site, Brooklyn, New York. Evaluated all RI data, performed fate and transport analysis, and evaluation of historic site operations to support facility *de minimis* status.

PROFESSIONAL TRAININGS

OSHA 40-Hour Health and Safety Course (29 CFR 1910.120)

OSHA 8-Hour Health and Safety Refresher Course (29 CFR 1910.120)

PUBLICATIONS

Significant Acceleration of Time Frame to Closure via Transition from Long-Term Biological Treatment to ZVI/EVO Injection, Kovacs, R., Senh, S., Silverstein, W., Moss, D., Kelley, R., Proceedings of the Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, 2016.

Strategy to Overcome Sub-Slab Depressurization System Design and Operational Challenges in an Existing Building With Sensitive Tenant Use, Henke, R., Kovacs, R., Kaiser, D., Proceedings of the Twelfth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, 2022.

PROFESSIONAL PROFILE

CONTACT INFORMATION

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EDUCATION

BE, Environmental Engineering, Hofstra University 1994
ME, Environmental Engineering, Manhattan College 1995

PROFESSIONAL LICENSES

Professional Engineer: New York, 2000

Omar Ramotar, PE

Principal Engineer

EXPERIENCE SUMMARY

Over twenty-seven years of experience: Staff, Project, Senior, and Principal Engineer with Roux.

TECHNICAL SPECIALTIES

Engineering services for the investigation, design, construction, operation, maintenance and monitoring of remedial systems for the remediation of contaminated soil, sediment, and groundwater.

REPRESENTATIVE PROJECTS

- Project Manager and Principal-in-Charge for a multi-element (large scale removal action [45,000 cubic yards of impacted materials excavated and consolidated on-site/disposed off-site], large scale subsurface feature and UST removal action, and remediation and restoration of a 3.2-acre seasonal pond located in the Massapequa Preserve) remedial design of a USEPA Superfund Site in Nassau County, New York. Responsible for the Preparation of USEPA response letters, technical drawings, and 95% and 100% remedial design documents in accordance with the Record of Decision and Consent Judgment.
- Project Manager and Principal-in-Charge for design of a natural wastewater treatment solution for a 3,000-acre new industrial complex in Saudi Arabia. Roux Associates was tasked to design an Engineered Natural System (to treat all wastewaters: sanitary, process and stormwater) from construction through operation, incorporate transitioning through phases, and plan for future expansion of the facility and increased wastewater flow rates. The 23-acre ENS was designed to treat a total flow of 1.4 million gallons per day. The major system components include: dump station with five truck hookup ports to collect and convey sanitary wastewater during construction of the facility; three primary sedimentation and anaerobic treatment tanks; one oil/water separator; six patented enhanced subsurface flow constructed treatment wetlands; two down flow disinfection filters; UV disinfection system; One treated water holding tank which conveys the treated water back to the facility for reuse within the refinery and as irrigations for landscaped areas; two infiltration basins; and six activated alumina treatment cells to remove fluoride from facility stormwater runoff.
- Project Manager and Principal-in-Charge for the bidding, contractor selection, and remediation of the wetland and canal portions of a 440-acre tract in western Staten Island that was used as a Major Oil Storage Facility (MOSF) for petroleum products until the end of 1995. Responsible for the preparation of a Remedial Action Work Plans, technical drawings, and 95% and 100% remedial design documents and for the remedial construction phase in accordance with the Site-specific Consent Order issued by the NYSDEC. Key elements of the Work include dredging/excavation of approximately 20,000 cubic yards of petroleum and lead impacted sediments/soils, off-site disposal, on-site capping and restoration of approximately 6.5 acres of disturbed wetlands. Routine activities included coordinating weekly construction meetings; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design, CAMP and project-specific erosion and sedimentation controls; and managing the overall project budget and schedule.
- Project Manager and Principal-in-Charge for the bidding, contractor selection, and remediation of a New York State Superfund Project. Responsible for the preparation of a Remedial Action Work Plans, technical drawings, remedial design documents and for the remedial construction phase in accordance with the Amended Record of Decision issued by the NYSDEC. Key elements of the Work include excavation and off-site disposal of

approximately 20,000 tons of VOC impacted soils, on-site capping and in situ chemical oxidation. Routine activities included coordinating weekly construction meetings and preparing associated meeting minutes; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design, CAMP and project-specific soil erosion and sedimentation controls; and managing the overall project budget and schedule.

- Project Manager for the bidding, contractor selection, and remedial construction phase at a 40-acre former metals manufacturing facility in Staten Island under the NYSDEC Voluntary Cleanup Program. Responsible for overall construction management for dredging/stabilization and off-site disposal of approximately 7,000 cubic yards of metal-impacted sediments from a tidally influenced embayment area and creek system, off-site disposal of approximately 3,000 cubic yards of sediment, on-site consolidation of approximately 4,000 cubic yards of sediment; capping of fill material/bank stabilization; in-place abandonment of former water and sanitary sewer system; construction of an 8 acre asphalt cap, installation of new stormwater sewer system and restoration and mitigation of approximately 2 acres of wetland areas disturbed by ongoing remedial activities. Routine activities included coordinating weekly construction meetings; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design; and managing the overall project budget and schedule.
- Project Construction Manager for a NYCDEP storm and sanitary sewer construction project in Brooklyn, New York. Work included design and construction of approximately 690 linear feet of RCP storm sewer, approximately 725 feet of ductile iron sanitary sewer, 6 new house connection spurs, new sewer and sanitary manholes and 12,000 square feet of asphalt removal and replacement. Routine activities included coordinating weekly construction meetings; ensuring Contractor compliance with remedial design, CAMP and SWPPP implementation; and managing the overall project budget and schedule.
- Project Manager for the preparation of a Feasibility Study Report and ongoing remediation of a 40-acre former manufacturing facility in Rensselaer, New York as part of the NY State Superfund Program. Responsible for the preparation and implementation of multiple large-scale IRM soil removal remedial actions resulting in approximately 12,000 tons of non-hazardous waste and 10,720 tons of hazardous waste shipped off-site. Also, responsible for the preparation and implementation of the remediation of two 80,000-square foot former wastewater treatment lagoons. Approximately 7,000 cubic yards of hazardous waste sediments shipped off-site. Approximately 4,000 cubic yards of riprap lining the perimeter of both lagoons mechanically screened to remove interstitial sludge within the riprap matrix. NYSDEC approval gained for on-site reuse of 3,200 tons of riprap saving the client approximately $400,000 in disposal costs. Provided ongoing support for various tasks associated with constructing, operating and maintaining the on-site groundwater treatment system.
- Principal Engineer and Project Manager for On-Site Environmental Monitor (OEM) Program implemented at the largest redevelopment project in New York City (over $5 billion). Required to ensure environmental compliance with regards to air, stormwater, noise, traffic, and other relevant environmental concerns during the performance of any construction related activity across the 22-acre redevelopment project Site. The Project consists of the construction of 30 buildings (commercial and residential); eight (8) acres of public open space and approximately 1,200 below grade parking spaces and some retail and community facility uses. The Project also includes the development and construction a new storage and maintenance rail yard facility for the Long Island Rail Road (LIRR) below grade across two city blocks over which a platform will be constructed along with six of the Project buildings and some of the open space.

Additional Soil and Groundwater Remediation Experience

- Principal in Charge and Project Manager for the preparation and implementation of a Remedial Action Work Plan (RAWP) at a former ink ribbon and carbon manufacturer in Glen Cove, New York. Scope of work included the removal of approximately 20,000 tons of listed-hazardous toluene-contaminated soil at various final excavation depths within 1.4-acre area, followed by ISCO injections across the excavated area. All on-site sources of contamination were removed, and on-site groundwater was remediated to Site cleanup levels within 18 months from initiation of Site construction activities. Prepared Final Engineering Report (FER) and Site Management Plan (SMP) as required by the NYSDEC.
- Principal in Charge and Project Manager for the source-area excavation and treatment of groundwater and soil grossly impacted by light non-aqueous phase liquid (LNAPL), volatile organic compounds (VOCs), and hazardous materials at a 33,150 square foot lot entered into a NYSDEC Brownfield Cleanup Agreement site in

Long Island City, New York. Prepared and certified the NYSDEC-required Remedial Action Work Plan, Site Management Plan and Final Engineering Report. Remediation efforts included removal of approximately 5,000 tons of grossly contaminated material removal using steel sheet piling and disposal/abandonment eleven (11) underground storage tanks (USTs) ranging in size from 2,000 to 25,000+ gallons that contain diesel fuel/fuel oil, mineral spirits, and linseed oil. In Situ Chemical Oxidation (ISCO) injections completed to address residual VOC contamination in soil and groundwater during the performance of the remedial action.

- Project Manager for the remedial design and remediation of a 23-acre former municipal landfill located in Glen Cove, New York as part of the NY State Superfund Program. The work was performed in accordance with Title 3 of the NYS Environmental Quality Bond Act under contract to the City of Glen Cove. Design elements included excavation of hazardous and radiological waste (8,500 cubic yards in total), 44,000 cubic yards of bulky waste, VOC and radiological waste monitoring, demo debris and waste separation and screening, dewatering, waste disposal, capping and site restoration. Additional work included the de-listing of a six acre “clean” portion of the site to allow the development of a ferry terminal and esplanade and development of alternative cleanup standards consistent with future site uses. Site remediation will accommodate site redevelopment as a commercial waterfront and operating ferry service and seaport area.
- Project Manager for the investigation and remediation of several sites spanning multiple blocks for a major pharmaceutical company in Brooklyn, New York. Environmental investigation is being conducted in preparation of possible property transfer. Responsibilities include development and preparation of investigation and remedial action work plans and coordination and management of resulting field investigation and remediation efforts. Project Engineer for a SVE/AS system to treat groundwater contaminated with VOCs and chlorinated VOCs at one 0.8-acre block. Designed and performed two SVE/AS pilot studies. Designed the full-scale SVE/AS system. Managed bidding, contractor selection, remedial construction, system start-up, operation, maintenance and monitoring phases for the full-scale SVE/AS system.
- Project Manager for the design of a soil and groundwater remediation system for a nationwide overnight delivery distribution center in Brooklyn, New York as part of the NYSDEC Voluntary Cleanup Program. A risk based remedial approach that called for the remediation of “hot spot” source area soils and mass-reduction of VOCs was successfully utilized for the Site. As a result, the focus of remediation was on reducing the mass of VOCs in on-site groundwater to a level where natural attenuation would be effective in remediation of VOCs. To address the contamination in the source area, a SVE/AS system consisting of 8 SVE wells and 17 AS wells was designed, constructed, operated, and maintained for a period of approximately 3 years. The SVE/AS system has been permanently shut down and the Site is currently in the post-remediation monitoring phase.
- Project Manager for the remediation of a former major pharmaceutical plant located in Hicksville, New York as part of the NY State Superfund Program. The project consisted of the excavation of non-hazardous soil from 5 on-site drywells and a former waste disposal area, implementation of a community air monitoring plan, coordination with the Long Island Rail Road (LIRR) for work performed within the LIRR’s right of way, steel sheeting installation and removal, backfilling, monitoring well abandonment and replacement, transportation and disposal of 3,300 tons of VOC, SVOC and metal contaminated soil, and restoration of approximately 9,800 square feet of asphalt. A 7-foot diameter steel caisson was used to support the deeper excavation required at the invert of two drywells. This innovative approach saved the client approximately $50,000 in costs that would have been incurred by using a traditional steel sheeting support system to protect the on-site commercial building.
- Project Engineer for the complete design, implementation, and startup of five distinct air sparge (AS) and soil vapor extraction (SVE) systems for the remediation of gasoline contaminated groundwater and soils. Pilot studies were performed at several locations at an 850-acre petroleum terminal site in Rhode Island and lead to the design of full-scale AS and SVE remediation systems that are being used in a phased approach, to remediate selected areas of the site. The designs included specialized modeling techniques to determine the optimum system requirements and components.
- Project Engineer for the design and construction management of a soil remediation project at a 28-acre former pesticide warehouse facility in Dayton, New Jersey. The project consisted of the excavation and on-site consolidation and capping of 7,500 cubic yards of pesticide contaminated soil. The capped areas were designed to be incorporated into a Site re development

plan for use as a storage and trailer parking lot. A Soil Erosion and Sedimentation Control Plan and a NJPDES General Permit were prepared for the project.

- Project Engineer for the design and remediation of a former sanitary wastewater leaching system at a 16.6-acre NYS RCRA site in Bethpage, New York. The project consisted of the excavation, staging, transportation, and disposal of VOC, SVOC, metal and pesticide contaminated soil. Approximately, 5,100 tons of non-hazardous soil, 1,300 tons of hazardous metals contaminated soil and 350 tons of hazardous VOCs contaminated soil. Structures remediated consisted of an imhoff tank, 33 leach pools, 2 distribution boxes, 2 stormwater drains, 2 sludge drying beds, and a blast fence area.
- Staff Engineer for the preparation and implementation of a Soil IRM plan for a major pharmaceutical plant in Brooklyn, New York as part of the NYSDEC Voluntary Cleanup Program. Work elements included contractor plan preparation, steel sheeting and removal, excavation of hazardous and non-hazardous waste, VOC and particulate monitoring, dewatering water management, waste transportation, disposal, and tracking, backfill placement and compaction. IRM Soil remediation included excavation of over 1,620 tons of non-hazardous soil and 524 tons of hazardous soil.
- Senior Engineer for design and construction of several elements of a 40 gpm treatment system for a 40-acre former manufacturing facility in Rensselaer, New York. BASF Site. Design support for 4,000 linear feet of collection trenches, 7 extraction well vaults, 2 air release chambers, and 2 groundwater re-injection galleries and a 50 foot by 60-foot treatment system containment pad. Coordination of construction efforts between mechanical and electrical contractors.
- Project Engineer for preparation and certification of Final Engineering Report and Site Management Plans for remediation of a 40-acre former metals manufacturing facility in Staten Island under the NYSDEC Voluntary Cleanup Program. Remediation included dredging/stabilization and off-site disposal of approximately 7,000 cubic yards of metal-impacted sediments from a tidally influenced embayment area and creek system, off-site disposal of approximately 3,000 cubic yards of sediment, on-site consolidation of approximately 4,000 cubic yards of sediment; capping of fill material/bank stabilization; in-place abandonment of former water and sanitary sewer system; construction of an 8 acre asphalt cap, installation of new stormwater sewer system and restoration and mitigation of approximately 2 acres of wetland areas disturbed by ongoing remedial activities. Routine activities included coordinating weekly construction meetings and preparing associated meeting minutes; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design; and managing the overall project budget and schedule.
- Project Engineer for preparation of Final Engineering Report and Site Management Plan for the remediation of a 40-acre former manufacturing facility in Rensselaer, New York as part of the NY State Superfund Program. Remediation included: multiple large-scale IRM soil removal remedial actions resulting in approximately 12,000 tons of non-hazardous waste and 10,720 tons of hazardous waste shipped off-site; remediation of two 80,000-square foot former wastewater treatment lagoons; groundwater containment and treatment system construction and Site-wide capping.

Additional Feasibility Study Experience

- Principal Engineer for the preparation of a Feasibility Study Report for a NYS Superfund Site in Glen Cove, New York. The Site is approximately 15 acres in size with a 1.4-acre portion of the site impacted by historical disposal of industrial wastes. Approximately 10,000 cubic yards of non-hazardous and hazardous waste has been identified to be potentially shipped off-site.
- Principal Engineer for preparation of a Focused Feasibility Study to optimize ongoing free-product recovery efforts for an 18-million-gallon release of petroleum hydrocarbon product from a former refinery and petroleum storage terminal in Brooklyn, New York. The remedial action objectives of the feasibility study were removal of free product to the extent practicable, prevention and/or elimination of any product seeps from the Site that result in visual petroleum product sheens on surface water and eliminate through removal, treatment, and/or containment the source of surface water contamination to the extent practicable. Technologies evaluated and retained included: Excavation, skimming, dual pump liquid extraction, water flooding, surfactant enhanced subsurface remediation, cosolvent flushing, vapor enhanced fluid recovery, enhanced fluid recovery, and natural source zone depletion.
- Project Manager and Senior Engineer for the preparation of a Remedial Action Selection (RAS) Report for a 9-acre landfill in Rensselaer, New York as part of the NYSDEC Voluntary Cleanup Program. The primary goal of the

RASR was to select a remedial alternative that was most protective of human health and the environment under the contemplated future use of the Site as a landfill with an integrated wildlife habitat vegetative cap. The final remedy for the landfill will include 1,000 linear feet of perimeter groundwater collection trenches, a 40-gpm treatment system for metals and VOCs and excavation and in situ chemical oxidation of VOC source areas.

- Project Engineer for the preparation of a Focused Feasibility Study (FFS) Report for the remediation of two dry wells at a formerly government owned, contractor operated, 105-acre New York State RCRA site in Bethpage, New York. The soils below and in the vicinity of each drywell were contaminated at various locations from 2 to 55 feet below land surface (bls) with PCBs exceeding NYSDEC standards. The FFS evaluated the following options: no action, in situ thermal desorption and excavation and off-site disposal. The no action alternative was recommended because the Site characterization and exposure assessment results indicated that there was no potential risk to persons using the Site for commercial or industrial activities, PCB impacted soils had been previously excavated to a depth of 28 feet bls and because PCBs are generally immobile in the environment, so migration is unlikely.

Additional Miscellaneous Design Experience

- Project Engineer for the design and construction management of a private vehicle fueling area at a New York City railyard. System components included: UST and process piping, level/monitoring systems, pump dispenser and keycard system, pump island, canopy and fire suppression system. Design met all substantive requirements of the New York City Fire Department (NYCFD) and New York City Department of Buildings (NYCDOB). Tasks included equipment selection, equipment sizing, piping layout, preparation of plans and specifications and shop drawing review and approval.

Additional Stormwater Design Experience

- Project Engineer for the design and construction management of a stormwater drainage project for a 28-acre former chemical pesticide manufacturing facility located in Dayton, New Jersey. The stormwater drainage system consisted of multiple catch basins, over 2,000 linear feet of reinforced concrete pipe ranging in size from 15 to 30 inches, and a recharge basin. The TR 55 computation method was used to size the drainage system for a 25-year storm event. The drainage system was designed in strict accordance with the New Jersey Department of Environmental Protection (NJDEP), the New Jersey Soil Conservation District (NJSCD) and the local planning departments.

Additional Engineered Natural System Design Experience

- Senior Engineer for the design of a compost treatment (CT) cell retrofitted into an existing sludge drying bed located at an integrated aluminum smelting and fabricating facility in Massena, New York. The principal objective of the CT will be to remove and sequester low level PCBs in the Site wastewater stream prior to discharge to the Site's permitted outfall. The proposed CT cell will be incorporated into the wastewater treatment process to evaluate PCB treatability in a CT environment as an alternative to other technologies currently being considered for the Site. The CT cell will be designed to accommodate variable hydraulic loading rates (10 to 70 gpm) and retention times in order to evaluate and define optimal system performance.

- Senior Engineer for the design of two pilot scale compost treatment (CT) systems for stormwater management at an active aluminum manufacturing facility in Lafayette, Indiana. The design included the retrofit of a 1,000 gallon above-grade septic tank (to handle a variable flow of 0.1 to 1 gpm) and a 100,000 gallon above-grade storage tank (to handle a variable flow of 10 to 50 gpm). The remedial goal of the pilot CT systems is for the removal of PCBs and aluminum from stormwater currently collected in the on-Site 100,000-gallon storage tank. The pilot systems were designed for incorporation into the existing stormwater system, thus precluding the need for additional permitting. The systems have been designed for year-round operation.

- Senior Engineer for the development of design improvements for a 45-acre former Landfill in Holtsville, New York to minimize the source of contamination to a downgradient pond and its' associated creek. A detailed budget water analysis was performed comparing current and proposed conditions to determine the best methods to minimize infiltration into the landfill and divert the stormwater runoff to the onsite recharge basin and away from the landfill. The proposed strategy currently entails modifying the existing stormwater conveyance controls (i.e., lining drainage swales), reducing the permeability of the landfill surface through the addition of recreational areas and lined stormwater storage ponds, and planting hybrid poplar trees to increase evapotranspiration at the Landfill. Overall, these modifications would be expected to reduce annual infiltration in the landfill surface from 24 inches to 18 inches, equivalent to approximately 8.2 million gallons of water annually.

- Project Engineer for the design of structural SMPs to manage runoff generated from a LEED certified 70,000 ft2 athletic facility, which is being constructed as part of a redevelopment of a 110-acre park facility in Staten Island, New York. Innovative structural stormwater management practices incorporated into the Site design include the following: micropool extended detention pond and infiltration basin. The pond will be comprised of a sedimentation forebay, shallow marsh, and pond. Suspended solids will drop out as runoff passes through the forebay, thereby enhancing treatment performance, reducing maintenance, and increasing the longevity of the system. The permanent pool provides additional dry storage capacity to mitigate peak flow rates prior to discharge into the overflow meadow. The forebay and pond are designed with shallow ledges along its fringe to support aquatic marsh plants. These wetland plants will aid in the stormwater treatment by impeding flow and trapping contaminants as they enter the forebay and pond. The fringe vegetation will stabilize and protect deposited sediments from resuspension during large storm events. The fringe wetland plants will include species such as rushes, reeds, and sedges, designed to improve water quality through the trapping and filtering of fine particles and soluble pollutants (metals, organics, and nutrients). Effluent from the micropool extended detention pond will then be discharged to an infiltration basin (i.e., Overflow Meadow) planted with a variety of native wildflower and wetland species for groundwater recharge.
- Project Engineer for the design of a pilot constructed treatment wetland system to treat stormwater discharge from an aluminum manufacturing facility located in Massena, New York. The 0.3-acre treatment system uses activated alumina and compost filter cells, and a sub-surface flow wetland to treat 1,400-4,300 gallons of stormwater daily.

Additional Operation and Maintenance (O&M) Experience

- Senior Engineer responsible for supporting the OM&M of a 40 gpm treatment system for a 40-acre former manufacturing facility in Rensselaer, New York. Processes and system maintained include aeration, bag filtration, air stripping, metals adsorption, liquid, and vapor phase carbon adsorption.
- Senior Engineer responsible for the O&M and monitoring of a soil vapor extraction (SVE) and air sparge (AS) system for nationwide distribution center in Brooklyn, New York as part of the NYSDEC Voluntary Cleanup Program. O&M activities included system operation and maintenance, performance monitoring, soil gas monitoring, quarterly monitoring, and preparation of quarterly and annual status reports for submission to the NYSDEC. The SVE and AS system consists of 8 SVE wells and 17 AS wells and was designed, constructed, operated and maintained for a period of approximately 3 years. The SVE and AS system has permanently shut down and the Site is currently in the post-remediation monitoring phase.
- Project Engineer responsible for the O&M of a 430 gpm, dual-phase, product recovery system in Greenpoint, Brooklyn, New York. Processes and system maintained include dual-phase groundwater and product recovery, low profile air strippers and a catalytic oxidation unit. The Site encompasses one of the nation's largest petroleum releases (18 million gallons).
- Project Engineer for the metals removal system upgrade of a 430 gpm, dual-phase, product-recovery system in Greenpoint, Brooklyn, New York. Upgrades included design, procurement, and construction oversight to install a metals removal system, allowing the remedial system to run at full capacity with minimal O&M. The metals removal system included two 10-foot diameter continuously backwashing sand filters, process liquid aeration system and ancillary equipment. The pre-design phase also included the performance of an extensive bench study to optimize the system design.
- Project Engineer for the control system upgrade of a 430 gpm, dual-phase, product-recovery system in Greenpoint, Brooklyn, New York. Upgrade included design procurement and construction oversight to install a new control system to eliminate intermittent power surges and sags which, in combination with the communication problems, had caused the previous control system to operate unpredictably. These upgrades included installation of new remote input/output systems, new uninterruptible power supplies and new remote communication cables at all six remote well sites.
- Staff Engineer for the O&M of a product recovery system in Howard Beach, New York. O&M activities include system maintenance and performance monitoring through on-site and off-site monitoring wells.
- Staff Engineer for the O&M of a 40 gpm groundwater remediation system at an industrial facility in Queens, New York as part of the State Superfund Program. O&M activities included system maintenance, effluent sampling, quarterly monitoring, and preparation of quarterly and annual status reports for submission to the NYSDEC.

- Staff Engineer for the design, implementation, and O&M for two remedial treatment facilities to remediate groundwater impacted by leaking USTs at two service garages owned by a New York state telecommunications company. The system was designed to treat groundwater at a flow-rate between 5 and 10 gpm using granular activated carbon adsorption treatment units.

Additional Health and Safety Management or Facility Decontamination or Demolition Experience

- Principal Engineer for the decontamination and decommissioning (D&D) of a 700,000+ square foot facility, in Brooklyn, New York for a major pharmaceutical company. The D&D activities were performed to allow for future use of the former facility for commercial, retail, and/or industrial purposes after renovation and redevelopment by others, by removing, cleaning, encapsulating or otherwise abating: (1) contaminants in indoor concrete identified during previous environmental investigations, (2) pharmaceutical manufacturing residues in ductwork identified during previous environmental investigations, (3) pharmaceutical manufacturing residues in select existing manufacturing infrastructure [including but not limited to relic air handling units (AHUs), dust collection systems, and air exhaust units], and performing partial interior building demolition and cleaning in connection with such infrastructure, (4) the horizontal drain piping associated with the eighth floor laboratories, and (5) paint containing polychlorinated biphenyls (PCBs) at a concentration of 50 milligrams per kilogram (mg/kg) or greater.
- Senior Engineer responsible for providing both worker and community Health and Safety through the monitoring of air particulates and VOCs during the electrical upgrade of pharmaceutical manufacturing facility in Brooklyn, New York. All work was performed in accordance with OSHA, NYSDEC and USEPA protocols for worker and community health and safety monitoring.
- Senior Engineer responsible for providing both worker and community Health and Safety through the monitoring of air particulates and VOCs during the construction of a parking lot redevelopment project for a pharmaceutical manufacturing facility in Brooklyn, New York. All work was performed in accordance with OSHA, NYSDEC and USEPA protocols for worker and community health and safety monitoring.
- Staff Engineer and Site Health and Safety Officer for the decommissioning of a pharmaceutical manufacturing facility in Brooklyn, New York. Responsibilities included construction oversight of all contractors for the following: dewatering, removal of 26 USTs ranging in capacity up to 30,000 gallons, excavation and stabilization of soil contaminated with VOCs, lead and mercury, and disposal of all waste generated. Additional responsibilities included providing both workers and community Health and Safety through the monitoring of air particulates, VOCs, and mercury vapors. All work was performed in accordance with OSHA, NYSDEC and USEPA protocols for worker and community health and safety monitoring.
- Staff Engineer and Site Health and Safety Officer providing construction oversight and management for the completion of a building demolition and UST Removal Program at a metals manufacturing facility in Staten Island, New York. The project included asbestos and lead abatement oversight prior to building demolition activities and the removal of six 550-gallon gasoline USTs, one 1,000-gallon No. 2 fuel oil UST and one 600-gallon No 2 fuel oil UST. A total of four buildings, two smelting kettles, a 200-foot emissions stack and a 50-foot water tower were removed as part of the demolition program. Responsibilities included providing both worker and community Health and Safety through the monitoring of air particulates and VOCs, performing all required sampling, waste disposal tracking to document all activities performed, providing construction oversight of all contractors, and preparing weekly progress reports.

Additional UST Experience

- Staff Engineer for the excavation oversight of 11 gasoline USTs, one waste oil UST, three pump islands and all associated underground and aboveground piping at a national railroad company in Queens, New York. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal of the USTs and preparation of a Closure Report.
- Staff Engineer for the excavation oversight of three 8,000-gallon USTs, two pump islands and all associated piping at a service station in Greenwich, New York. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal, cleaning, and disposal of the USTs and preparation of a Closure Report.

PROFESSIONAL TRAININGS

OSHA 40-hour Health & Safety Course, 1995

OSHA 8-hour Health & Safety Refresher Course, 1996-2021

Julia Michaels
Project Scientist

TECHNICAL SPECIALTIES

Management and field implementation of Remedial Investigations for sites in regulatory programs including the New York State Brownfields Cleanup Program (BCP) and the New York City Office of Environmental Remediation Volunteer Cleanup Program. Management and field implementation of Phytoremediation Plots, Wetland Delineation, and Forest Management. Preparation, and management of Remedial Investigation Work Plans and Remedial Investigation Reports. Remedial construction and soil excavation oversight, management of waste characterization and removal, environmental site assessments focusing on soil, groundwater and soil vapor investigations using multiple sampling techniques.

EXPERIENCE SUMMARY

Five years of experience: Project Scientist, Staff Scientist, Staff Assistant Scientist; Roux Environmental Engineering and Geology, D.P.C., Islandia, New York.

CREDENTIALS AND TRAINING

B.S. Environmental Science, Villanova University, 2018

B.A. Geography, Villanova University, 2018

OSHA 40-Hour HAZWOPER Training, 2018

OSHA 10-Hour Construction Safety Training, 2018

OSHA 30-Hour Construction Safety Training, 2019

OSHA 8-Hour Refresher Training, Certificate Current

LIRR Contractor Safety and Security Training, 2018

Transportation Worker Identification Credential, 2018

First Aid and CPR Certified, 2019

KEY PROJECTS

- Project manager for the inspections of a 75-acre hybrid poplar phytoremediation plot as a component of closure on an active petroleum refinery and terminal in East Providence, Rhode Island as part of an implemented Engineered Natural System. The phytoremediation plot is designed to hydraulically control and remediate contaminants from a dissolved-phase groundwater plume. The performance evaluation includes tri-annual seasonal monitoring and growth measurements, modeling of evapotranspiration, evaluation of recent groundwater measurements, and supporting the authoring of the annual report to be submitted to the Rhode Island Department of Environmental Management.
- Project Manager for the Remedial Action Groundwater Monitoring contaminated with VOCs and chlorinated solvents at a 0.8-acre NYSDEC Voluntary Cleanup Site in Brooklyn, New York. Responsibilities include NYSDEC correspondence, report preparation, work plan preparation, and field staff management for groundwater quarterly groundwater sampling.
- Project Manager for a freshwater pond nutrient analysis and mitigation investigation in Southampton, New York. Project objective was to assess nutrient loading, and mechanically remove nutrient sources. Responsibility included design, sampling, and analysis of groundwater and surface water, as well as prepare a conceptual plan for mechanical means of removal.
- Project Manager for former fibers facility in Williamsburg, Virginia. Project components include land management for wildlife enhancement projects, Phytotechnology monitoring, and permitting. Baseline vegetation survey completed including mapping of all habitat types present. Wildlife monitoring surveys for bats, birds, amphibians, reptiles, mammals and insects. Wildlife projects implemented include creation of pollinator meadow areas, warm season grasslands, sustainable forestry management, purple martin colony, blue bird trail, bat housing, native bee housing, and vernal pool monitoring. Wildlife Habitat Council Wildlife at Work certification earned for wildlife projects.
- Field manager for the nontidal wetland delineation of a park in North Hempstead, New York. Responsibility included preparation of field documents and assisting in performing the wetland delineation, collection of GPS points, and development of post delineation report and figure.
- Field Manager for neighboring redevelopment Sites in the NYSDEC BCP, located in Bronx, New York. Responsibilities included implementing a Community Air Monitoring Program (CAMP), managing soils including transportation and disposal, collecting *in situ* waste characterization soil samples, and maintaining communication between subcontractors and Roux office support.

- Field manager for the Remedial Investigation of a redevelopment Site in East Orange, New Jersey that contained seven former and one operating dry cleaner, three former fueling stations, and a former automotive repair shop. Responsibilities included oversight of New Jersey-specific monitoring well installation and collection of soil and groundwater samples for suspected contamination of chlorinated solvents.
- Field manager of a Phase II investigation of surface water nutrient loading at a site in East Hampton, New York. Field responsibilities included oversight of piezometer well installation, and field management of groundwater sampling and surface water sampling at twenty-two locations along a tidally influenced creek.
- Field manager for Phase II investigation at a Site in Glen Cove, New York. The Site formerly operated as an ink ribbon and carbon manufacturer, and portions of the Site were previously remediated under the NYS Superfund and the USEPA RCRA Closure Programs. Responsibilities included soil vapor, soil, sediment, and groundwater sampling and implementation of a methane delineation program.
- Assisted in the implementation of a large-scale waste characterization program for a major redevelopment project in Elmont, New York. Project included coordination and oversight of *in situ* waste characterization sampling of over 405,000 tons of soil.
- Assisted in annual groundwater sampling monitoring program at a former petroleum refinery and terminal in Brooklyn, New York. This work was done to monitor the largest subsurface free-product plume in North America. Fieldwork responsibilities included the sampling of over fifty wells for petroleum contaminated groundwater using multiple sampling methods.
- Assisted in the Pre-Design Investigation and Waste Characterization sampling event for a New York State BCP project in Brooklyn, New York. The site was an automotive dealership and maintenance facility with heavy petroleum and chlorinated solvent contamination in the soil and groundwater. Field responsibilities included oversight of Geoprobe direct push rig, health and safety oversight, *in situ* waste characterization, and groundwater sampling.
- Field manager of a Phase II remedial investigation for due diligence support at a site in New Rochelle, New York. Field responsibilities included soil vapor sampling, groundwater sampling, and soil sampling to investigate recognized environmental concerns on behalf of a potential buyer.
- Site Safety Officer for various remedial investigation sites. Responsibilities include preparation of health and safety plans (HASPs); job safety analysis (JSA) documents development and review; onsite safety meeting management; safety document preparation (Lessons Learned, Near Loss, Field Audits, etc.); and planning/execution of corrective actions.

JUDY V. HARRY

P. O. Box 208
120 Cobble Creek Rd.
North Creek, NY 12853

Occupation:	Data Validator/Environmental Technical Consultant
Years Experience:	45
Education:	B.S., Chemistry, Magna cum laude, 1976, Phi Beta Kappa
Certifications:	New York State Woman-Owned Business Enterprise (WBE)
Relevant Work History:	

Data Validation Services: September 1989 - present

Sole proprietor of Data Validation Services, a woman-owned small business registered with SAM, providing consultation/validation services to regulatory and commercial clients.

These services include the review of analytical laboratory data for compliance with respect to specific protocols, accuracy and defensibility of data, verification of reported values, and evaluation of quality parameters for analytical usability of results. Approved by USEPA, NYSDEC, NJDEP, NYSERDA, and NYCDEP as a data validator for projects, including USEPA Superfund, Brownfield, and lead sites, and those contracted through the NYSDEC Division of Hazardous Waste Remediation, Division of Solid Waste, and Division of Water Quality.

Performed validation for compliance with laboratory analytical protocols including USEPA OLM, USEPA OLC, USEPA ILM, USEPA DFLM, USEPA SOW3/90, USEPA SOW 7/87 CLP, USEPA SOW 2/88 CLP, USEPA SW846, RCRA, AFCEE, NYS 6 NYCRR Part 360, 40 CFR, Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, including TO-15, 1989/1991/1995/2000/2005 NYSDEC ASPs, and 1987 NYSDEC CLP.

Performed validation according to the USEPA National and Regional SOPs and Functional Guidelines, AFCEE requirements, NYSDEC Validation Scope of Work, NYS DUSR, and NJDEP Division of Hazardous Site Mitigation/Publicly Funded Site Remediation SOPs.

Performed validation for USEPA Superfund Sites including Salem Acres, York Oil, Port Washington L-4 Landfill, Bridgeport Rental and Oil Services, GE-MRFA, MMR/ OTIS AFB, LCP, and Peter Cooper site; and for USEPA lead sites including SJ&J Piconne, Maska, Bowe System, Jones Sanitation, and Syossett Landfill, involving CLP, RAS, and SAS protocols.

Contracted for NYSDEC Superfund Standby Contracts with LMS Engineers/HDR, CDM Smith, Malcolm-Pirnie/ARCADIS, Ecology & Environment, Shaw Environmental/APTIM, CG&I, O’Brien & Gere Engineers, and EC Jordan, involving samples collected at NYS Superfund Sites and analyzed under the NYSDEC ASP.

Performed validation services for NYSDEC Phase II remedial investigations, RI/FS projects, Brownfield sites, and PRP over-site projects for hazardous waste sites.

Performed validation services for clients conducting RI/FS activities involving samples of many matrices, including waste, air, sludges, leachates, solids/sediments, aqueous, and biota.

Clients have included AECOM, ARCADIS, Barton & Loguidice, Benchmark Engineering, Bergmann Associates, Blasland, Bouck & Lee, Brown and Caldwell, CDM Smith, CB&I Shaw Environmental, C&S Consulting Engineers, Chazen Companies, Clough Harbour & Associates, Columbia Analytical Services, C.T. Male, Dames & Moore, Day Engineering, EA Engineering, EcolSciences, Ecology & Environment, Ecosystems, EC Jordan, Environmental Chemical Corporation, EHRT, ENSR Consulting, ELM, ERM-Northeast, Fagan Engineers, Fanning Phillips & Molnar, FluorDaniel GTI, Frontier, Foster Wheeler Environmental Corp, Frontier Technical, Galson Consultants, GEI, GE&R, Geomatrix Consultants, GZA Environmental, Handex of N, Hazard Evaluations, H2M Group, HDR, HRP, IT Corp, Jacques Whitford, JTM Associates, JMT, Labella Associates, Langan Engineers, Leader Environmental, Lockwood, Kessler & Bartlett, LMS Engineers, Malcolm-Pirnie, Metcalf & Eddy, NWEC&C, O'Brien & Gere Engineers, Pace, Parsons Engineering-Science, Plumley Engineering, Prescott Environmental, P. W. Grosser, Rizzo Associates, Roux Associates, Sear Brown Group, SECOR, Shaw Environmental, Stantec, ThermoRemediation Inc., TRC Environmental, Turnkey Environmental Restoration, TVGA Engineering, URS Consultants, Wehran Emcon, Weston, Wittman Geosciences, YEC, and private firms.

Provided consultation services to laboratories regarding analytical procedures and protocol interpretation, and to law firms for litigation support.

Provided services to firms involving audits of environmental analytical laboratories to determine analytical capability, particularly for compliance with NYSDEC ASP and AFCEE requirements.

Guest speaker on a panel discussing Data Review/Compliance and Usability, for an analysis workshop for the New York Association of Approved Environmental Laboratories, 1993.

Adirondack Environmental Services: June 1987 - August 1989

Senior mass spectroscopist for AES. Responsible for GC/MS analyses of environmental samples by USEPA and NYSDEC protocols, development of the GC/MS laboratory, initiating the instrumental and computer operations from the point of installation, and for implementing the procedures and methodologies for Contract Laboratory Protocol.

CompuChem Laboratories: May 1982 - January 1987

Managed a GC/MS production laboratory; developed, implemented, and supervised QA/QC criteria at three different levels of review; and was responsible for the development and production of the analysis of environmental and clinical samples. Directed a staff of 23 technical and clerical personnel, and managed the extraction and GC/MS labs and data review operations.

Research Triangle Institute (RTI): December 1979 - May 1982

Worked as an analytical research chemist responsible for development of analytical methods for the EPA Federal Register at RTI. This involved analysis of biological and environmental samples for priority pollutants, primarily relating to wastewaters and to human sampling studies. Method development included modification and interfacing of the initially developed Tekmar volatile purge apparatus to GC/MS, development and refinement of methods for entrapment and concentration of the air medium for subsequent volatile analysis, and the analysis and resolution/ identification of individual PCB congeners within Aroclor mixtures by capillary column and mass spectra.

Guardsman Chemical Company: February 1977 - November 1979

Performed all quality control functions for the manufacturing plant. Performed research and development on coatings and dyes.

Almay Cosmetics: May 1976 - December 1976

Product evaluation chemist. Responsible for analytical QC of manufactured products.

Publication

Pellizzzari, E.D., Moseley, M.A., Cooper, S.D., Harry, J.V., Demian, B., & Mullin, M. D. (1985). Recent Advances in the Analysis of Polychlorinated Biphenyls in Environmental and Biological Media. *Journal of Chromatography*, 334(3) 277-314.

ATTACHMENT 2

Laboratory's Standard Operating Procedures eurofins | Environment Testing

Eurofins Denver

Electronic Document Cover

Eurofins TestAmerica Laboratories, Inc.
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Title: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Water, Solid, and Biosolids by LC/MS/MS [Method 1633]

Electronic Copy Only

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1. Scope and Application

1.1. This procedure describes the analysis of water, soil, solids, and biosolids samples for the following compounds using liquid chromatography / tandem mass spectrometry (LC/MS/MS).

Table 1.1
PFAS Supported

Compound Name	**Abbreviations**	**CAS #**
Perfluoroalkylcarboxylic 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	PFTeDA	376-06-7
Perfluorinated sulfonic acids (PFSAs)		
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
Perfluorododecansulfonic acid	PFDoS	79780-39-5
Perfluorinated sulfonamides (FOSAs)		
Perfluorooctanesulfonamide	PFOSA, (FOSA)	754-91-6
N-ethylperfluorooctanesulfonamide	NEtFOSA (Et-FOSA)	4151-50-2
N-methylperfluorooctanesulfonamide	NMeFOSA (Me-FOSA)	31506-32-8
Perfluorinated sulfonamide ethanols (FOSEs)		
2-(N-ethylperfluorooctanesulfonamido) ethanol	NEtFOSE (Et-FOSE)	1691-99-2
2-(N-methylperfluorooctanesulfonamido) ethanol	NMeFOSE (Me-FOSE)	24448-09-7
Perfluorinated sulfonamidoacetic acids (FOSAAs)		
N-ethylperfluorooctanesulfonamidoacetic acid	NEtFOSAA (EtFOSAA)	2991-50-6

Table 1.1
PFAS Supported

Compound Name	**Abbreviations**	**CAS #**
N-methylperfluoro octanesulfonamidoacetic acid	NMeFOSAA (MeFOSAA)	2355-31-9
Fluorotelomer sulfonic acids (FTS)		
1H,1H,2H,2H-perfluorohexane sulfonic acid *(4:2)*	4:2 FTS	757124-72-4
1H,1H,2H,2H-perfluorooctane sulfonic acid *(6:2)*	6:2 FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonic acid *(8:2)*	8:2 FTS	39108-34-4
Fluorotelomer carboxylic acids (FTCAs)		
3-Perfluoropropyl propanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentyl propanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptyl propanoic acid	7:3 FTCA	812-70-4
Per-and Polyfluoroether carboxylic acids		
Perfluoro(2-propoxypropanoic) acid or Hexafluoropropylene oxide dimer acid	HFPO-DA, GenX	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	DONA, ADONA(1)	919005-14-4
Perfluoro-3-methoxypropanoic acid (PFMPA)	PFMPA (PFECA F)	377-73-1
Perfluoro-4-methoxybutanoic acid (PFMBA)	PFMBA (PFECA A)	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	NFDHA (PFECA B)	151772-58-6
Ether sulfonic acids		
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA (PES)	113507-82-7

Note*: Abbreviations in parenthesis are the abbreviations used by the laboratory's LIMS where they differ from the abbreviation listed in Method 1633*.

(1) In some literature, the acronym ADONA refers to the ammonium salt, CAS 958445-44-8, and DONA refers to the parent acid. In Method 1633, ADONA refers to the parent acid. DONA is the acronym present on the laboratory raw data.

1.2. This method contains the sample extraction and analysis.

1.3. The working range of the method is listed below. The linear range can be extended by diluting the extracts. Note that all compounds are reported in their acid form.

Reporting limits and Method Detection Limits for individual compounds are provided in Table 1.

Table 1.2
Reporting Limits and Working Range

Matrix	Nominal Sample Size	Reporting Limit	Working Range
Water	500 mL	2 ng/L – 50 ng/L	2 ng/L - 1560 ng/L
Leachate	100 mL	10 ng/L – 250 ng/L	10 ng/L – 7800 ng/L
Solid	5 g	0.2 ng/g – 5.0 ng/g	0.2 ng/g - 156 ng/g
Biosolids	0.5 g	2 ng/g – 50ng/g	2 ng/g – 1560ng/g

1.4. For DOD/DOE criteria, see Table B-24 in the QSM.

2. Summary of Method

2.1. Water samples are extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide (NH4OH)/methanol solution.

2.2. Solid/biosolids samples are extracted with a NH4OH/methanol solution using agitation over three extractions. The extract is centrifuged and diluted with water prior to SPE.

2.3. The final extracts are analyzed by LC/MS/MS. PFAS are separated from other components on a C18 column with a solvent gradient program using 10 mM ammonium acetate/water/acetonitrile (95/5) and acetonitrile. The mass spectrometer detector is operated in the electrospray (ESI) negative ion mode for the analysis of PFAS.

2.4. An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDA) consist of carbon-13 labeled analogs or deuterated analogs of the compounds of interest, and they are fortified into the samples at the time of extraction. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related interferences to the same extent as the compounds of concern. Compounds that do not have an identically labeled analog are quantitated by the IDA method using a closely related labeled analog.

2.5. Quantitation by the internal standard method is employed for the IDA analytes/recoveries. Peak response is measured as the area of the peak.

3. Definitions

3.1. PFCAs: Perfluorocarboxylic acids

3.2. PFSAs: Perfluorinated sulfonic acids

3.3. FOSA: Perfluorinated sulfonamide

3.4. PFOA: Perfluorooctanoic acid

3.5. PFOS: Perfluorooctane sulfonic acid

3.6. PTFE: Polytetrafluoroethylene (e.g. Teflon®)

3.7. SPE: Solid phase extraction

3.8. PP: Polypropylene

3.9. PE: Polyethylene

3.10. HDPE: High density polyethylene

3.11. AFFF: Aqueous Film Forming Foam

3.12. TDCA: Taurodeoxycholic acid

3.13. TCDA: Taurochenodeoxycholic acid

3.14. TUDCA: Tauroursodeoxycholic acid

3.15. IDA: Isotope dilution analyte (equivalent to EIS in reference method)

3.16. IS: Internal Standard (equivalent to NIS in reference method)

3.17. LCS: Laboratory control sample (equivalent to OPR in reference method)

3.18. Refer to the Glossary of the Eurofins Denver Quality Assurance Manual (QAM) for definitions of general analytical and QA/QC terms.

4. Interferences

4.1. PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean (i.e., no contribution greater than ½ the quantitation (reporting) limit. These items are listed below in Section 6.

4.2. To avoid contamination of samples, standards are prepared in a ventilation hood in an area separate from where samples are extracted.

4.3. PTFE products can be a source of PFOA contamination. The use of PTFE in the procedure should be avoided or at least thoroughly tested before use. Polypropylene (PP) or polyethylene (PE, HDPE) products may be used in place of PTFE products to minimize PFOA contamination.

4.3.1. Standards and samples are injected from polypropylene autosampler vials with polypropylene screw caps once. Multiple injections may be performed on Primers when conditioning the instrument for analysis.

4.3.2. Random evaporation losses have been observed with the polypropylene caps causing high IDA recovery after the vial was punctured and sample re-injected. For this reason, it is best to inject standards and samples once in the analytical sequence.

4.3.3. Teflon-lined screw caps have detected PFAS at low concentrations. Repeated injection from the same Teflon-lined screw cap have detected PFNA at increasing concentration as each repeated injection was performed, therefore, it is best to use polypropylene screw caps.

4.4. Volumetric glassware and syringes are difficult to clean after being used for solutions containing high levels of PFOA. These items should be labeled for use only with similarly concentrated solutions or verified clean prior to re-use. To the extent possible, disposable labware is used.

4.5. Both branched and linear PFAS isomers can potentially be found in the environment. Linear and branched isomers are known to exist for PFOS, PFOA, PFHxS, PFBS, Et-FOSAA, and Me-FOSAA based upon the scientific literature. If multiple isomers are present for one of these PFAS they might be adjacent peaks that completely resolve or not, but usually with a deflection point resolved during peak integration. The later of these peaks matches the retention time of its labeled linear analog. In general, earlier peaks are the branched isomers and are not the result of peak splitting.

As of this writing, PFOS, PFOA, PFHxS, FOSA, Et-FOSA, Me-FOSA, Et-FOSE, ME-FOSE, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

4.6. In an attempt to reduce PFOS bias, it is required that m/z 499>80 transition be used as the quantitation transition.

4.7. Aluminum foil should not be used for this analysis due to the potential interferences from the PFAS used as release agents.

4.8. All parts of the SPE manifold must be cleaned with 1% Ammonium Hydroxide in methanol and air dried prior to use. Sonicate all components that will fit into an ultrasonic bath with 1% Ammonium Hydroxide in methanol. When in use, after loading the same but prior to elution procedure, the manifold chamber must be rinsed with 1% ammonium hydroxide in methanol.

5. Safety

5.1. Employees must abide by the policies and procedures in the Environmental Health and Safety Manual, Radiation Safety Manual, and this document. All work must be stopped in the event of a known or potential compromise to the health or safety of an associate. The situation must be reported **immediately** to a supervisor, the EH&S Staff, or a senior manager.

5.2. This procedure may involve hazardous material, operations, and equipment. This SOP does not purport to address all the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum

5.3. Specific Safety Concerns

5.3.1. Preliminary toxicity studies indicate that PFAS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFAS and PFAS samples must be handled in the laboratory as hazardous and toxic chemicals.

5.3.2. The use of a filtering syringe with the SPE cartridge, if and when needed, presents an extreme risk of ergonomic injury due to the force needed to push a sample through a clogged cartridge. The risk includes both set-up and body position around the sample. Use step boxes to position oneself above the syringe and manifold and use ones entire body weight rather than just a thumb. Take routine breaks to offset the hazard.

5.3.3. Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

5.3.4. Laboratory procedures such as repetitive use of pipets, repetitive transferring of extracts and manipulation of filled separatory funnels and other glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager, or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it.

5.3.5. Eye protection that satisfies ANSI Z87.1 (as per the NDSC Safety Manual), laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.3.6. Perfluorocarboxylic acids are acids and are not compatible with strong bases.

5.3.7. Methanol is highly flammable and is used throughout this procedure. Methanol should be stored away from any ignition sources and kept in closed containers with secondary containment measures or within a fume hood.

5.3.8. The use of vacuum systems presents the risk of imploding glassware. All glassware used during vacuum operations must be thoroughly inspected prior to each use. Glass that is chipped, scratched, cracked, rubbed, or marred in any manner must not be used under vacuum. It must be removed from service and replaced.

5.3.9. Glass containers are not to be used for “tumbling” soil samples.

5.4. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the SDS for each of the materials listed in the table**. A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

Material$^{(1)}$	Hazards	Exposure Limit$^{(2)}$	Signs and Symptoms of Exposure
Acetic Acid (3-2-1)	Corrosive Poison Flammable	10 ppm-TWA 15 ppm-STEL	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.
Acetonitrile (2-3-0)	Flammable Poison	20 ppm-TWA	Early symptoms may include nose and throat irritation, flushing of the face, and chest tightness. Prolonged exposure to high levels of vapors may cause formation of cyanide anions in the body.
Ammonium Hydroxide (3-1-0)	Corrosive Poison	50 ppm-TWA	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal.
Formic Acid (3-2-1)	Flammable Corrosive Toxic Irritant	5 ppm TWA 10 ppm STEL	Extremely destructive on contact with skin, mucous membranes, eyes, upper respiratory tract. Inhalation may result in spasms, inflammation and edema. Symptoms include burning sensation, coughing, wheezing, shortness of breath, headache, nausea, vomiting, depression.

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm PEL 250 ppm STEL	Harmful if swallowed, or absorbed through the skin. Causes eye, skin and respiratory tract irritation, and may cause central nervous system depression. A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Potassium Hydroxide (3-0-1)	Corrosive Poison	2 mg/m^3 (Ceiling)	Symptoms of inhalation may include coughing, sneezing, damage to the nasal or respiratory tract. High concentrations can cause lung damage. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes with tearing, redness, swelling.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6. Equipment and Supplies

Due to the ubiquitous nature of PFAS, all disposable equipment (including, but not limited to vials, pipet tips, and SPE manifold parts) that directly contacts a sample or extract is subject to QC checks on a by-lot basis prior to use. At a minimum, the QC checks include either a rinse with DI water or an extraction with basic methanol to mimic the usage encountered during sample preparation. QC check data is kept on file for reference as needed. Processes for cleaning extraction manifolds and associated components are described in DV-OP-0004, *Glassware Cleaning*.

6.1. 15 mL polypropylene test tubes with polypropylene screw caps.

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 500, 250 and 125 mL HDPE bottles with HDPE screw caps. The average weight of the HDPE bottles with HDPE screw caps are calibrated once per year. The calibration is performed by weighing 10 bottles with caps and dividing by 10 to get the average weight.

6.4. Analytical balance capable of accurately weighing to the nearest 0.0001 g, and checked for accuracy each day it is used in accordance with DV-QA-0014.

6.5. Extract concentrator or nitrogen manifold with water bath heating to 65°C

6.6. Syringe filter, PALL/Acrodisc 0.2 um Nylon membrane, 25 mm, or equivalent. Do not use PTFE type filters.

6.7. 300 µL autosampler vials, polypropylene, with polypropylene screw caps, Waters PN 1860004112, or equivalent

6.8. SPE columns

6.8.1. Waters Oasis WAX 150 mg/6 cc (PN 186002493) or equivalent for DoD/DOE QSM samples

6.8.2. Phenomenex Strata PFAS WAX/GCB, 200mg/50mg/6cc (PN DZPRO-SPE) or equivalent. This cartridge incorporates a graphitized carbon

6.9. Graphitized carbon (Envi-Carb^{TM} or equivalent) for DoD/DOE QSM samples

6.10. Silanized glass wool, Sigma-Aldrich PN 20411. Rinse with methanol 2 times and store in clean glass jar prior to use. Pack to half the height of WAX SPE cartridge barrel

6.11. Vacuum manifold for Solid Phase Extraction (SPE)

6.12. Vacuum pump

6.13. Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc.). These should be disposable where possible, or marked and segregated for high-level versus low-level use

6.14. pH indicator paper, JT Baker Baker-pHIX pH 2.0-9.0, or equivalent

6.15. Centrifuge (Thermo Scientific Sorvall Legend X1, or equivalent), capable of reaching at least 4500 rpm

6.16. Vortex Mixer (Scientific Industries model SI-0236 or equivalent)

6.17. Shaker table (Eberbach model 6010, or equivalent) for soil extractions

6.18. Oven, capable of maintaining a temperature of 104ºC (±1ºC)

6.19. Pre-weighed 47 mm filter, Environmental Express part #F93447MM or equivalent

6.20. Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS) –The instrument described below, or equivalent, may be used for this method. The HPLC is equipped with a refrigerated autosampler, an injection valve, and a pump capable of variable flow rate. The use of a column heater is required to maintain a stable temperature throughout the analytical run. Data is processed using Chrom Peak Review, version 2.3 or equivalent. The MS/MS is capable of running in the NI-ESI mode at the recommended flow rate with a minimum of 10 scans per peak.

6.20.1. SCIEX LC/MS/MS

This system consists of a Shimadzu HPLC interfaced with a SCIEX 5500+ Triple Quad MS, or equivalent. The instrument control and data acquisition software is SCIEX Analyst, version 1.6.3 or equivalent.

6.20.1.1. Shimadzu LC-40D HPLC equipped with an autosampler, two LC-40D pumps, one degassing unit, and one column oven, or equivalent.

6.20.1.2. Phenomenex Gemini C_{18} 3 µm, 2.0 mm x 50 mm, Part No. 00B-4439-B0, or equivalent.

6.20.1.3. PFAS Isolator column, Phenomenex Luna C_{18} 5 µm, 30 mm x 3 mm, part no. 00A-4252-Y0 or equivalent. This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

6.21. Preventive and routine maintenance is described in the table below

Table 6.21
HPLC/MS/MS Preventative Maintenance

As Needed:	**Daily (When in use)**
Change pump seals Change in-line filters in autosampler (HPLC) Check/replace in-line frit if excessive pressure or poor performance Replace column if no change following in-line frit change Clean corona needle Replace fused silica tube in ESI interface Clean lenses/Curtain Plate Clean skimmer Create all eluents in Reagent module, label eluent containers with TALS label and place 2nd label into maintenance log when put into use.	Check solvent reservoirs for sufficient level of solvent Verify that pump is primed, operating pulse free Check needle wash reservoir for sufficient solvent Verify capillary heater temperature functioning Verify vaporizer heater temperature Verify rough pump oil levels Verify turbo-pump functioning Verify nitrogen pressure for auxiliary and sheath gasses Verify that corona and multiplier are functioning
Semi-Annually	**Annually**
Replace rough-pump oil (4-6 months). Replace oil mist and odor elements. Replace activated alumina filter if applicable	Vacuum system components including fans and fan covers. Clean/replace fan filters, if applicable.

7. Reagents and Standards

7.1. Reagent grade chemicals shall be used in all tests whenever available. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on the Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.1.1. Acetic acid, glacial

7.1.2. Acetonitrile, JT Baker, HPLC Grade

7.1.3. Ammonium acetate (solid salt).

7.1.3.1. Ammonium acetate (10 M in water): Prepared by weighing 38.5 g of ammonium acetate and dissolving in 50 mL of water.

7.1.3.2. Ammonium acetate (10 mM in 95:5 Water: Acetonitrile): Prepared by transferring 1 mL of 10 M Ammonium Acetate solution into 999 mL of 95:5 Water: Acetonitrile for a total of 1L. This solution should be replaced every 7 days.

7.1.4. Ammonium hydroxide (NH_4OH), 30% in water, ACS reagent grade

7.1.4.1. Ammonium hydroxide (NH_4OH), 3% in water: Prepared by diluting 10 mL of ammonium hydroxide (30%) with 90 mL of reagent water for a total volume of 100 mL. Replace after 3 months.

7.1.4.2. Ammonium hydroxide (NH_4OH), 0.3% in methanol (v/v): Prepared by diluting 10 mL of ammonium hydroxide (30%) into 990 mL of methanol for a total of 1 L.

7.1.4.3. Ammonium hydroxide (NH4OH), 1% in methanol (v/v): Prepared by diluting 33 mL of ammonium hydroxide into 967 mL of methanol for a total of 1 L.

7.1.5. Formic Acid, greater than 96% purity or equivalent, ACS reagent grade

7.1.5.1. Formic Acid, 0.1 M, in water: Prepared by dissolving 4.6 g (3.77 mL) of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.5.2. Formic Acid, 0.3 M, in water: Prepared by dissolving 13.8 g (11.3 mL) of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.5.3. Formic Acid, 5% in water(v/v): Prepared by diluting 5 mL of formic acid into 95 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.5.4. Formic Acid, 50% in water(v/v): Prepared by diluting 50 mL of formic acid with 50 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.5.5. 1:1 0.1 M formic acid:methanol (v/v); Prepared by mixing equal volumes of methanol and 0.1 M formic acid. Replace after 2 years.

7.1.6. Methanol (MeOH)

7.1.7. Potassium Hydroxide (KOH) (solid, reagent grade).

7.1.7.1. Potassium hydroxide, 0.4% in methanol (w/v): Prepared by weighing 16 g of potassium hydroxide and dissolving in 4 L of methanol.

7.1.8. Ottawa Sand (blank matrix for solid samples)

7.1.9. Water, Nanopure or Millipore, must be free of interference and target analytes.

7.1.9.1. 95:5 Water: Acetonitrile: Prepared by diluting 200 mL of Acetonitrile with 3800 mL of Water. Final volume is 4 L.

7.1.10. Nitrogen, Ultra High Purity, used for the ESI interface, collision cell, and concentration of extracts.

7.1.11. Air, Ultra-Pure, used for vacuum and source gas.

7.1.12. 30:70 methanol: water (v/v), prepared by diluting 30 mL methanol with 70 mL HPLC reagent water or equivalent volume in respect to the ratio.

7.1.13. Instrument Blanks solution (94.375% MeOH, 4% H2O, 1% NH_4OH, 0.625% acetic acid): Prepare by combining 18.848 mL of MeOH, 0.348 mL reagent water, 0.128 mL glacial acetic acid and 0.676 mL 30% Ammonium Hydroxide in water. This solution is used to dilute the extracts of samples that exceed the calibration range (Section 12.1). Replace after 1 month.

7.1.14. Calibration solution (59% NH_4OH, 0.625% acetic acid in water): Prepare by combining 11.8 mL of NH_4OH and 2.2 mL of acetic acid and bring to final volume of 20 mL using HPLC grade water. Replace after 1 year.

7.2. Standards

7.2.1. PFAS are purchased as high purity solids (96% or greater) or as certified solutions. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor. Vendor expiration dates are used by the lab. Stocks and working solutions are given a 1-year expiration.

7.2.2. As of this writing, only PFOS, PFOA, PFHxS, FOSA, Et-FOSA, Me-FOSA, Et-FOSE, Me-FOSE, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

7.2.3. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 0 - 6°C. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

7.2.4. PFBS, PFHxS, PFHpS, PFOS, PFDS, and other PFAS are not available in the acid form, but rather as their corresponding salts, such as sodium or potassium. The standards are prepared and corrected for their salt content according to the equation below.

$$\text{Mass}_{acid} = \text{Measured Mass}_{salt} \times \text{MW}_{acid} / \text{MW}_{salt}$$

Where: MW_{acid} is the molecular weight of PFAA

MW_{salt} is the molecular weight of the purchased salt.

For example, the molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore, the amount of NaPFOS used must be adjusted by a factor of 0.956.

7.2.5. For the primary source calibration solutions, individual solutions for each PFAS (both native and isotopically labelled) or PFAS mixtures (both native and isotopically labelled) are purchased from Wellington Laboratories, or other reputable vendors, and are predominantly at a concentration of 50 ug/mL in basic methanol for individual compounds or 1-5000 ng/mL in basic methanol for mixtures. In the case of the sulfonic compounds, the concentration is of the alkali (potassium or sodium) salt. The laboratory uses the concentration of the acid form when determining the concentration of individual sulfonic acids in solution (See Section 7.2.4 above).

7.2.6. While PFAS standards commercially purchased are supplied in glass ampoules, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene or HDPE containers. Vortex all standard solutions prior to removing aliquots.

7.3. **LC1633sp_IM: Intermediate spike solution, 80-2000 ng/L (nominal)** 100 ml of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the intermediate for the upper range of the ICAL and to create the QC spiking solution in sample preparation, using the recipe below:

Table 7.3
LC1633sp_IM Solution Recipe
The solutions below are combined and diluted to 100 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)
PFBA	50	0.64	0.320	6:2 FTS	47.4	0.64	0.300
PFPeA	50	0.32	0.160	8:2 FTS	47.9	0.64	0.300
PFHxA	50	0.16	0.080	FOSA	50	0.16	0.080
PFHpA	50	0.16	0.080	Me-FOSA	100	0.08	0.080
PFOA	50	0.16	0.080	Et-FOSA	100	0.08	0.080
PFNA	50	0.16	0.080	Me-FOSAA	50	0.16	0.080
PFDA	50	0.16	0.080	Et-FOSAA	50	0.16	0.080
PFUdA	50	0.16	0.080	Me-FOSE	50	1.60	0.800
PFDoA	50	0.16	0.080	Et-FOSE	50	1.60	0.800
PFTrDA	50	0.16	0.080	HFPO-DA	50	0.64	0.320
PFTeDA	50	0.16	0.080	DONA	47.1	0.64	0.300
PFBS	44.2	0.16	0.070	PFMPA (PFECA F)	50	0.32	0.160
PFPeS	46.9	0.16	0.075	PFMPA	50	0.32	0.160

Table 7.3
LC1633sp_IM Solution Recipe
The solutions below are combined and diluted to 100 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)
				(PFECA A)			
PFHxS	45.5	0.16	0.073	NFDHA (PFECA B)	50	0.32	0.160
PFHpS	47.6	0.16	0.076	9Cl-PF3ONS	46.6	0.64	0.300
PFOS	46.6	0.16	0.074	11Cl-PF3OUdS	47.1	0.64	0.300
PFNS	48	0.16	0.077	PFEESA (PES)	44.5	0.32	0.320
PFDS	48.2	0.16	0.077	3:3 FTCA	50	0.800	0.400
PFDoS	48.4	0.16	0.078	5:3 FTCA	50	4.00	2.00
4:2 FTS	46.7	0.64	0.300	7:3 FTCA	50	4.00	2.00

7.4. LC1633EPALSP: LCS Analyte Solution, 14-400 ng/mL (nominal)

100 ml of the LC1633sp_IM intermediate stock solution is diluted to a final volume of 500 mL using methanol. This mixed stock is used as an intermediate for the lower range of the ICAL and the LCS spike solution.

7.5. LC1633_EIS: 1633 Isotope Dilution Analyte Solution (Extracted Internal Standards (EIS)), 25-500 ng/mL

The 1633-EIS solution is added to all samples prior to extraction and used as an intermediate solution for preparation of the instrument calibration standards. 500 mL of the solution at a nominal concentration of 25-500 ng/mL is prepared from the individual solutions described in Section 7.2.5. using the recipe below:

Table 7.4
LC1633_EIS Recipe
The solutions below are combined and diluted to 500 mL with Methanol.

IDA/EIS	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)	IDA/EIS	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)
13C4-PFBA	50	2.00	0.20	13C8-PFOS	47.8	0.500	0.0478
13C5-PFPeA	50	1.00	0.10	13C2-4:2FTS	46.7	1.00	0.0934
13C5-PFHxA	50	0.500	0.050	13C2-6:2FTS	47.5	1.00	0.0950
13C4-PFHpA	50	0.500	0.050	13C2-8:2FTS	47.9	1.00	0.0958

Table 7.4
LC1633_EIS Recipe
The solutions below are combined and diluted to 500 mL with Methanol.

IDA/EIS	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)	IDA/EIS	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)
13C8-PFOA	50	0.500	0.050	13C8-FOSA	50	0.500	0.050
13C9-PFNA	50	0.250	0.025	d3-MeFOSA	50	0.500	0.050
13C6-PFDA	50	0.250	0.025	d5-EtFOSA	50	0.500	0.050
13C7-PFUdA	50	0.250	0.025	d3-MeFOSAA	50	1.00	0.100
13C2-PFDoA	50	0.250	0.025	d5-EtFOSAA	50	1.00	0.100
13C2-PFTeDA	50	0.250	0.025	d7-Me-FOSE	50	5.00	0.500
13C3-PFBS	46.5	0.500	0.0465	d9-Et-FOSE	50	5.00	0.500
13C3-PFHxS	50	0.500	0.047	13C3-HFPO-DA	50	2.00	0.200

7.6. LC1633_NIS: 1633 Internal Standard Analyte Solution (Non-Extracted Internal Standards (NIS)), 100-400 ng/mL

The 1633 IS solution is added to all extracts prior to analysis and used as an intermediate solution for preparation of the instrument calibration standards. 250 mL of the solution at a nominal concentration of 100-400 ng/mL is prepared from the individual solutions described in Section 7.2.5 using the recipe below.

Table 7.6
1633-IS Recipe
The solutions below are combined and diluted to 250 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)
13C3-PFBA	50	2.0	0.400	13C2-PFDA	50	0.5	0.100
13C2-PFHxA	50	1.0	0.200	18O2-PFHxS	47.3	1.0	0.189
13C4-PFOA	50	1.0	0.200	13C4-PFOS	47.8	1.0	0.191
13C5-PFNA	50	0.5	0.100				

7.7. Calibration Standards

Calibration solutions are prepared from the standards described in Sections 7.3, 7.4, 7.6, and 7.6, above. For each level, a 10 mL volumetric flask is filled with approx. 2 mL of Methanol. Add 1450 µL of 59% NH4OH/11% Acetic acid v/v in water (Section 7.1.14) and the appropriate amount (see table below) of the solutions are added, and then the flask is filled to the mark with methanol.

Table 7.7
1633 Calibration Solution Recipe

PFAS Standards	Volume (mL) to add in 25 mL FV (25 mL)								
	CS-1	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**	**CS-8**	**CS-10**
LC1633sp_IM (0.080-2.0 µg/mL)	0	0	0	0	0	0	1.575	3.90	19.525
LC1633EPALSP (0.014-0.400 µg/mL)	0.0825	0.1625	0.325	0.775	1.95	3.9	0	0	0
LC1633_EIS (0.025-0.5 µg/mL)	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
LC1633_NIS (0.1-0.4 µg/mL)	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125	0.3125

7.7.1. Initial Calibration (ICAL) Levels (ng/mL)

Table 7.7.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8	CS-10
PFBA	0.2	0.4	0.8	2	5	10	20	50	250
PFPeA	0.1	0.2	0.4	1	2.5	5	10	25	125
PFHxA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFHpA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFOA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFNA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFDA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFUdA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFDoA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFTrDA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFTeDA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
PFBS	0.0442	0.0884	0.1768	0.442	1.105	2.21	4.42	11.05	55.25
PFPeS	0.0469	0.0938	0.1876	0.469	1.1725	2.345	4.69	11.725	58.625
PFHxS*	0.0455	0.091	0.182	0.455	1.1375	2.275	4.55	11.375	56.875
PFHpS	0.0476	0.0952	0.1904	0.476	1.19	2.38	4.76	11.9	59.5
PFOS*	0.0464	0.0928	0.1856	0.464	1.16	2.32	4.64	11.6	58
PFNS	0.048	0.096	0.192	0.48	1.2	2.4	4.8	12	60
PFDS	0.0482	0.0964	0.1928	0.482	1.205	2.41	4.82	12.05	60.25
PFDoS	0.0484	0.0968	0.1936	0.484	1.21	2.42	4.84	12.1	60.5
4:2 FTS	0.1868	0.3736	0.7472	1.868	4.67	9.34	18.68	46.7	233.5
6:2 FTS	0.1896	0.3792	0.7584	1.896	4.74	9.48	18.96	47.4	237
8:2 FTS	0.1916	0.3832	0.7664	1.916	4.79	9.58	19.16	47.9	239.5
FOSA	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Me-FOSA*	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Et-FOSA*	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Me-FOSAA*	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5

Table 7.7.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8	CS-10
Et-FOSAA*	0.05	0.1	0.2	0.5	1.25	2.5	5	12.5	62.5
Me-FOSE*	0.5	1	2	5	12.5	25	50	125	625
Et-FOSE*	0.5	1	2	5	12.5	25	50	125	625
HFPO-DA	0.2	0.4	0.8	2	5	10	20	50	250
DONA	0.1884	0.3768	0.7536	1.884	4.71	9.42	18.84	47.1	235.5
PFMPA (PFECA F)	0.1	0.2	0.4	1	2.5	5	10	25	125
PFMBA (PFECA A)	0.1	0.2	0.4	1	2.5	5	10	25	125
NFDHA (PFECA B)	0.1	0.2	0.4	1	2.5	5	10	25	125
9Cl-PF3ONS	0.1864	0.3728	0.7456	1.864	4.66	9.32	18.64	46.6	233
11Cl-PF3OUdS	0.1884	0.3768	0.7536	1.884	4.71	9.42	18.84	47.1	235.5
PFEESA (PES)	0.089	0.178	0.356	0.89	2.225	4.45	8.9	22.25	111.25
3:3 FTCA	0.2496	0.4992	0.9984	2.496	6.24	12.48	24.96	62.4	312
5:3 FTCA	1.248	2.496	4.992	12.48	31.2	62.4	124.8	312	1560
7:3 FTCA	1.248	2.496	4.992	12.48	31.2	62.4	124.8	312	1560
Labeled Isotope Dilution Analytes (IDA)									
13C4-PFBA	10	10	10	10	10	10	10	10	10
13C5-PFPeA	5	5	5	5	5	5	5	5	5
13C5-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C9-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C6-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C7-PFUdA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C3-PFBS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C3-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C2-4:2 FTS	5	5	5	5	5	5	5	5	5
13C2-6:2FTS	5	5	5	5	5	5	5	5	5
13C2-8:2FTS	5	5	5	5	5	5	5	5	5
13C8-FOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-MeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d5-EtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-MeFOSAA	5	5	5	5	5	5	5	5	5
d5-EtFOSAA	5	5	5	5	5	5	5	5	5
d7-Me-FOSE	25	25	25	25	25	25	25	25	25
d9-Et-FOSE	25	25	25	25	25	25	25	25	25
13C3-HFPO-DA	10	10	10	10	10	10	10	10	10
Internal Standard (IS)									
13C3-PFBA	5	5	5	5	5	5	5	5	5
13C2-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Table 7.7.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8	CS-10
13C4-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C5-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2-PFHxS	2.365	2.365	2.365	2.365	2.365	2.365	2.365	2.365	2.365
13C4-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

** Both branched and linear isomers are used.*

***Note**: The above calibration levels are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program.*

7.7.2. A technical (qualitative) grade standard which contains both linear and branched isomers for PFOA and PFNA is used as a retention time (RT) marker. This is used to integrate the total response for both linear and branched isomers of these analytes in environmental samples while relying on the initial calibration with the linear isomer quantitative standard. This technical (qualitative) grade standard is analyzed with every initial calibration and at the beginning of a daily sequence.

7.7.2.1. Additionally, standards of the bile acids (TDCA, {TUDCA and TCDA only if eluent is not acetonitrile}) at approximately 1.0 µg/mL are to be analyzed, after or with the qualitative standard for the initial calibration and prior to samples on non-ICAL days, and any time when DoD samples are analyzed. Be certain to attach those chromatograms to the document listed in Section 7.7.2.2.

7.7.2.2. Attach this document to the ICV from the associated ICAL by scanning the document and associating it to the file as a document type of High Res MS Tune in TALS and to the CCVL on non-CAL days. Use the following naming convention: "_TSTD_Instrument_Date." Example: _TSTD_LCMS9_15Mar2022.

7.7.2.3. The daily checks are attached to the CCVL of the sequence on non-CAL days.

7.8. LC1633_ICV Initial Calibration Verification Standard (ICV)

7.8.1. The ICV is prepared from commercially available mixed solutions from Wellington including PFC-MXF, PFC-MXG, PFC-MXH, PFC-MXI, and PFC-MXJ mixtures.

When available, individual stock solutions may be purchased from a vendor other than Wellington laboratories. If not available, a second lot from Wellington is sourced, and if that is not available, a second laboratory chemist will prepare the intermediate mixed solution for the ICV.

7.8.2. The mixes are combined with NIS and ESI by filling a 10 mL flask with approximately 2 mL of methanol and 580 µL of 59% NH_4OH/11% Acetic acid v/v in water (Section 7.1.14). The appropriate amount (see table below) of the solutions is added, and then the flask is filled to the mark with methanol to achieve the ratio of 94.375% MeOH, 4% H2O, 1% NH_4OH, 0.625% acetic acid.

Table 7.8.2
LC1633_ICV Recipe

PFAS Standards	Volume (mL) to add in 10 mL FV
PFAC-MXF	0.200
PFAC-MXG	0.250
PFAC-MXH	0.050
PFAC-MXI	0.050
PFAC-MXJ	0.025
LC1633_EIS	0.500
LC1633_NIS	0.125

8. Sample Collection, Preservation, and Storage

Laboratory default requirements for sample containers, sample size, preservation and holding time are detailed in the table below.

Table 8
Sample Collection, Preservation, and Storage Requirements

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time
Water	2x 500 mL 1x 125 ml (TSS) HDPE bottle	500 mL	0-6°C	28 days if 0-6°C(1)
Solids	4 oz. HDPE wide-mouth container (2) (Separate jar for %moisture)	20 g	0-6°C	90 days

(1) There is a potential for transformation of Et-FOSE, Me-FOSE, Et-FOSAA, or Me-FOSAA in aqueous samples stored at 0-6ºC for more than 7 days. The transformation may cause a high bias in the observed concentration of other PFAS.

(2) If the sample is dewatered or cake (solid) then it may be collected in a 4oz soil jar. If sample is between 3-30% solids, then client should notify lab and request appropriate sample containers. Samples can split by the laboratory into solid and liquid phases for analysis upon request.

Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.

8.1. Extracts are stored at 0 - 6°C and must be analyzed within 28 days of extraction.

8.2. Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

8.3. Biphasic samples

8.3.1. Samples denoted as aqueous (groundwaters, surface waters, and wastewaters) with less than approximately 50 mg of solids content are prepared and handled as a liquid sample (Section 10.2) as determined by total suspected solids (TSS) analysis or per an experienced analyst. If a sample contains more than 50 mg solids, determine the TSS in the sample to then assess an appropriate extraction volume. If required by the client, contact the client for authorization to extract the sample at a reduced volume. Per client request, samples with more than 50 ppm TSS may require a second cartridge to be prepared in the event of cartridge clogging. In severe cases, the client will be contacted to determine if the sample should be extracted as a solid or liquid. Detailed descriptions of any deviations from the procedure must be documented in the LIMS NCM program. NCMs will be included for samples that have discoloration, excessive TSS or organic matter, organisms, odors, etc.

8.3.2. TSS Procedure

8.3.2.1. Use the 250 or 125 mL bottle

8.3.2.2. Aliquot a small volume for PFAS Pre-Screening

8.3.2.3. Use a pre-weighted filter (ProWeigh Filter)

8.3.2.4. Label each dish with a sample identifier

8.3.2.5. Scan each dish into the “Dish Value” field of the TALS batch

8.3.2.6. Copy the documented weight into the TALS batch as the “Tare Weight”

8.3.2.7. Assemble the needed filter apparatus

8.3.2.8. Insert the pre-weighed filter into the apparatus

1. MB = HPLC grade water
2. LCS = Celite, 500 mg/L TSS

8.3.2.9. Condition the filter with 10 mL of reagent water

8.3.2.10. Filter 10 mL of well-mixed sample through the filter to get a representative sample

8.3.2.11. Dry the filter for ~10 seconds by drawing vacuum through the filter

8.3.2.12. Use tweezers to carefully transfer the filter from the filtering apparatus back to its pre-weighed dish.

8.3.2.13. Dry the filter for a minimum of 1 hour at 104ºC ±1ºC

8.3.2.14. Transfer the filter to a rack until cool

8.3.2.15. Weigh the filter and residue using an analytical balance

8.3.2.16. Enter this value into the TALS batch as the “WT1” value.

8.3.2.17. Make sure the following values are correctly entered into the TALS batch

- Initial amount: 10 mL
- Final amount: 10 mL
- Nominal Amount Used = 10 mL (on batch information page)

8.3.2.18. TALS will calculate the TSS as follows:

Equation 1

$$TSS\ mg/L = \frac{Weight\ after\ drying\ (WT1)(mg) - Tare\ Weight\ (mg)}{0.01\ L}$$

8.3.2.19. If the TSS > 100 mg/L (50 mg/500 mL), then extract at a reduced volume.

8.3.2.20. An appropriate dilution will target a TSS of < 100 mg/L. Factors of 2, 4, and 10 should be used when determining the appropriate volume.

TSS (mg/L)	Volume reduction	Volume of sample
0-100	1x	500 mL
100-200	2x	250 mL
200-400	4x	100 mL
>400	10x	50 mL

Note: Under Batch Information, set “Perform Calculation” to “1” and “Nominal Amount Used” to 10 to perform auto calculations.

8.3.3. Samples considered solids (biosolids, sediments, and soils) are prepared and handled as solid samples following appropriate homogenization as per Section 10.6. Correction for moisture content is provided through the LIMS when required by the client.

8.3.4. In the event that results are required individually for the solid and aqueous phases of a sample, the phases are separated via centrifugation, and extracted separately using the appropriate preparation (Section 10.2 for the aqueous phase and Section 10.6 for the solid phase). The extracts are analyzed, and results reported for each phase separately.

9. Quality Control

9.1. The minimum quality controls (QC), acceptance criteria, and corrective actions are described in this section. When processing samples in the laboratory, use the Eurofins Denver LIMS (TALS) Method Comments to determine specific QC requirements that apply. For SOPs that address only preparation, QC acceptable limits on the Initial Demonstration of Capability (IDOC)

9.1.1. The laboratory’s standard QC requirements, the process of establishing control limits, and the use of control charts are described more completely in Eurofins Denver policy DV-QA-003P *Quality Control Program*.

9.1.2. Specific QC requirements for Federal programs, e.g., Department of Defense (DoD), Department of Energy (DOE), etc., are described in Eurofins Denver policy DV-QA-024P *QA/QC Requirements for Federal Programs*. This procedure meets all criteria for DoD QSM unless otherwise stated. Any deviation or exceptions from QSM requirements must have prior approval in the project requirements.

9.1.3. Project-specific requirements can override the requirements presented in this section when there is a written agreement between the laboratory and the client, and the source of those requirements should be described in the project documents. Project-specific requirements are communicated to the analyst via Method Comments in the LIMS and the Quality Assurance Summaries (QAS) in the public folders.

9.1.4. Any QC result that fails to meet control criteria must be documented in a Nonconformance Memo (NCM). The NCM is automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA group periodically reviews NCMs for potential trends. The NCM process is described in more detail in SOP DV-QA-0031 *Non -Conformance and Corrective Action System*. This is in addition to the corrective actions described in the following sections.

9.2. Initial Performance Studies

Before analyzing samples, the laboratory must establish a method detection limit (MDL). In addition, an initial demonstration of capability (IDOC) must be performed by each analyst on the instrument he/she will be using. On-going proficiency must be demonstrated by each analyst on an annual basis. See Section 12 for more details on detection limit studies, initial demonstrations of capability, and analyst training and qualification.

9.3. Batch Definition

Batches are defined at the sample preparation step. The batch is a set of up to 20 samples of the same matrix, plus required QC samples, processed using the same procedures and reagents within the same time period. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. See QC policy DV-QA-003P *Quality control Program* for further details.

9.3.1. The quality control batch must contain a low level laboratory control sample (LLCS), a laboratory control sample (LCS) and a method blank. Laboratory generated QC samples (Blank, LLCS, LCS,) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, a matrix spike/matrix spike duplicate (MS/MSD) may be included in the batch. In the event that multiple MS/MSDs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

9.4. QC Samples

9.4.1. Method Blank:

1.1.1 One method blank (MB, laboratory reagent blank) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. For aqueous samples, the method blank is an aliquot of laboratory reagent water. For solid samples, the method blank is an aliquot of Ottawa sand wetted with reagent water. The method blank is processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, and then implemented when target analytes are detected in the method blank above the reporting limit or when IDA recoveries are outside of the control limits. Re-extraction of the blank, other batch QC and the affected samples are required when the method blank is deemed unacceptable. See policy DV-QA-003P *Quality Control Program* for specific acceptance criteria.

9.4.1.1. If the MB produces a peak within the retention time window of any of the analytes, determine the source of the contamination and eliminate the interference before processing samples.

9.4.1.2. The method blank must not contain any analyte at or above the reporting limit, greater than 1/3 the regulatory compliance limit or at or above 10% of the measured concentration of that analyte in the associated samples, whichever is higher.

9.4.1.2.1. DoD/DOE QSM: in addition to the above criteria, the method blank must not contain any analyte at or above ½ the reporting limit.

9.4.1.3. If there is no target analyte greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with qualifiers. Such action should be taken in consultation with the client.

9.4.1.4. Re-extraction and reanalysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the samples.

9.4.1.5. Refer to DV-QC-003P *Quality Control Program* for further details of the corrective actions.

9.4.1.6. The position of the method blank does not need to be rotated in the SPE manifold during SPE extraction if liners and reservoirs are rotated.

9.5. Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD)

A laboratory control sample (LCS), defined as OPR (on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte are outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LCS is deemed unacceptable. See DV-QA-003P *Quality Control Program* for specific acceptance criteria.

9.5.1. The control limits for the LCS are stored in TALS. As of this revision (Rev 2, 3rd Draft of Draft Method 1633), limits for aqueous samples are method defined. Limits for solids are advisory.

9.5.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40% for target PFAS.

9.6. Low Level Laboratory Control Sample (LLCS)

Low level LCS (LLCS), defined as LLOPR (low-level on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LLCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and at a concentration of twice the RL. The LLCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte are outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LLCS is deemed unacceptable. See DV-QA-003P *Quality Control Program* for specific acceptance criteria.

9.6.1. The control limits for the LCS are stored in TALS. As of this revision (Rev 2, 3rd Draft of Draft Method 1633), limits for aqueous samples are method defined. Limits for solids are advisory.

9.6.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40%.

9.7. A laboratory duplicate (DU) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. A DU is a second aliquot of a selected field sample that must be processed in the same manner and at the same time as the associated samples. If a client does not provide extra sample volume for a laboratory duplicate, a LCS/LCSD would be extracted to assess precision (Section 9.9). Any RPD failures must be documented in an NCM. RPD limits are stored in TALS.

9.8. Matrix Spike/ Matrix Spike Duplicate (MS/MSD)

Matrix spikes are not required for this method because any deleterious effect of the matrix is evident in the recoveries of the IDA. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) can be processed per client request. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Spiked analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, and then implemented when recoveries of any spiked analyte are outside of the control limits provided by TALS or by the client. Recovery limits for MS/MSD are the same as those used for the LCS.

9.8.1. For DoD/DOE QSM, the RPD limit for the MS/MSD pair is less than or equal to 30%.

9.9. A laboratory control sample duplicate (LCSD) may be added when insufficient sample volume is provided to process either a DU or MS/MSD pair, or is requested by the client. The LCSD is evaluated in the same manner as the LCS.

9.10. Instrument blanks (RB or CCB)

Instrument blanks are required at the beginning of an analytical sequence, after high level samples (>UCL) and every CCV. The blank should contain EIS and NIS to quantitate results. The blank should not contain any analyte > MDL. See DV-QA-003P *Quality Control Program* for specific acceptance criteria.

9.11. Initial calibration verification (ICV)

A second source standard is analyzed with the initial calibration curve. The concentration should be at the mid-range of the curve.

Corrective actions for the ICV include:

- Rerun the ICV
- Remake or acquire a new ICV
- Evaluate the instrument conditions(remake eluent, clean curtain plate)
- Evaluate the initial calibration standards
- Rerun the initial calibration

9.12. Isotope Dilution Analytes (Extractable Internal Standards (EIS))

9.12.1. The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 10 (Procedure). As described in Section 7 (Reagents and Standards), this solution consists of isotopically labeled analogs of the analytes of interest.

9.12.2. IDA recoveries are flagged if they are outside of the acceptance limits stored in TALS. If IDA recoveries are outside of these limits, additional clean-up may be needed. If the recoveries cannot be met after clean up then re-extract a smaller aliquot.

9.12.2.1. If the IDA is just outside the control limits, re-analyze the extract at 1x prior to re-extraction. If in control, report the data.

9.12.3. Once sufficient data has been gathered, limits based on historical recoveries may be generated and implemented.

9.12.4. For DoD/DOE QSM, EIS limits based on historical recoveries are required. The lower recovery limit must be greater than or equal to 20%.

9.13. Ion Ratio

9.13.1. Compare the quantifier/qualifier SRM transition ratio in the sample to the SRM transition ratio in the standard.

Equation 2

$$Ion\ Ratio = \frac{Area\ Quantitation\ Ion\ (1^\circ\ Transition)}{Area\ Qualitative\ Ion\ (2^\circ\ Transition)}$$

9.13.2. The quantifier/qualifier SRM ion ratio should be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the mid-level ICAL point.

9.13.2.1. If data is reported to the MDL the ratio should also be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the initial daily CCV.

NOTE: two transition are monitored for PFPeA, but no corrective action is required if the ratio is outside the limits due to the extremely poor response for the qualifier transition.

9.13.3. If the ion ratio does not meet criteria after corrective actions, (extract clean-up, sample dilution, etc.), then data should be qualified if the ratio is not met.

9.13.3.1. Ion ratios must be in control in calibration solutions. If they are outside of limits, stop the analysis and correct the issues.

9.14. Internal Standards (Non-extractable Internal Standards (NIS))

Internal standards are spiked into every field sample, QC sample, standard, and instrument blank. They are used for quantitation of the IDA.

9.14.1. For Draft Method 1633, the internal standard area in the field and QC samples must be between 30-200% of the most recent CCV.

9.14.2. For DoD/DOE QSM, the following instances are required to be greater than the 30% of the average area of the calibration standards:

- The internal standard areas in undiluted extracts
- The internal standard areas in sample extracts where additional IS was added post-dilution.
- The internal standard areas in diluted extracts, once corrected for the dilution factor, when additional IS was not added post-dilution.

10. Procedure

10.1. One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a non-conformance memo (NCM). The NCM process is described in more detail in SOP DV-QA-0031 *Non-Conformance and Corrective Action System*. The NCM shall be filed in the project file and addressed in the case narrative.

Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

Differences for samples run in accordance with the DoD/DOE QSM version 5.4 or higher are called out as needed in the procedures below.

10.2. Water Sample Preparation

10.2.1. Visually inspect samples for the presence of settled and/or suspended sediment/particulates. Samples >50 mg solids should be evaluated prior to extraction (Section 8.3.2 TSS Procedure). Compare sample to reference/comparison bottle. If the sample should be processed as a solid, biphasic, or reduced volume, contact the client for guidance prior to such action if contractually required. Invert samples to homogenize prior to adding any spiking solutions.

10.2.1.1. If TSS is > 100 mg/L, centrifugation may mitigate the sample clogging the cartridge in lieu of dilution.

10.2.2. Unknown samples may be screened prior to extraction using an external calibration curve and a 100x dilution factor.

10.2.2.1. Screening procedure may involve a reduced instrument run time and sample prep.

10.2.2.2. Evaluate the screening results to determine an appropriate volume to extract. If the on-column concentration is:

- <0.5 ng/mL = 1x (500 mL)
- Between 0.5 – 5 ng/mL = 10x (50 mL)
- Between 5 – 50 ng/mL = 100x (5 mL)
- Between 50 – 500 ng/mL = 1,000x (0.5 mL)
- Between 500 – 5000 ng/mL = 10,000x (0.05 mL)

10.2.3. Weigh the sample container prior to extraction and then weigh the sample container after extraction to determine the initial volume. Unless otherwise directed by client, use the entire sample volume, and spike directly into the sample container.

10.2.3.1. If the sample is identified as a leachate, prep at 100 mL. Sample should be collected in an appropriately sized container (i.e. 100-125 mL). If not, document the incorrect bottle type using an NCM and use a 100mL aliquot for the analysis.

10.2.4. Prepare additional aliquots of a field sample for the DU and MS/MSD, if requested.

10.2.5. Prepare three (3) 500 mL aliquots of HPLC-grade water for the method blank, LLCS and LCS, dependent upon container type submitted by the client. If a client specific DU and MS/MSD is not available, prep a fourth QC sample for the LCSD.

10.2.6. Check that the pH is 6.5 ± 0.5. If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

10.2.7. Vortex the LC1633EPALSP Native spike and LC1633_EIS IDA Mix solutions prior to use.

10.2.8. Add 0.250 mL of LC1633_EIS (Section 7.5) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample vial.

10.2.9. Spike the LCS and MS/MSD (if requested) with 1.0 mL of LC1633EPALSP Spike solution (Section 7.4), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

10.2.10. Spike the LLCS with the 100 µL of the LC1633EPALSP Spike solution (Section 7.4) using a 100µL or 200 µL pipette, for a fixed concentration of 0.32-8.0 ng/mL in the final sample vial.

10.2.11. Swirl or vortex all samples after adding spike solutions.

10.3. Solid Phase Extraction (SPE) of Aqueous Samples

10.3.1. Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel. As necessary, pack glass wool into the reservoir.

10.3.2. Condition the SPE cartridges (Section 6.8.2, Phenomenex Strata PFAS WAX/GCB, 200mg/50mg/6cc or equivalent) by passing the following solutions without drying the column.

10.3.2.1. For DOD/DOE samples, use the Oasis Wax Cartridges (Section 6.8.1)

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

10.3.3. Wash with 15.0 mL of 1.0% NH_4OH/methanol.

10.3.4. Wash with 5.0 mL of 0.3M formic acid. Close valve when ~ 200 µL remains on top to keep column wet. If needed, use HPLC grade water to keep the cartridge wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

10.3.5. Appropriately label the columns and add the reservoir to the column. The QC samples do not need to be rotates as long a new liners and clean reservoirs as used with each batch.

10.3.6. Pour the samples into the reservoirs attached to the SPE columns and with vacuum, pull the entire sample volume through the cartridge at a rate of approximately 2 to 5 drops per second.

10.3.6.1. If the SPE column should clog (flow rate 1 drop every 10 seconds) prior to the entire content of the sample container passing through the column do the following:

1. Stop adding sample to the reservoir.
2. Return any remaining sample volume back to the original container.
3. Weigh the original container and record this weight into the worksheet notes field within the TALS extraction batch.
4. Determine the full volume of sample fortified by using the "Gross Weight" – (remaining sample volume – empty bottle weight)
5. Enter this value into the "Initial Amount" field in the TALS extraction batch.
6. Proceed to Section 10.4, noting that additional vacuum or pressure might be needed to elute the SPE column. If the cartridge remains clogged, use a syringe filter and hand pressure to add positive pressure to the cartridge.

10.3.7. After the entire sample has been loaded onto the column, rinse the sample bottle with two 5 mL aliquots of reagent water and pour into the column reservoir.

10.3.8. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL of 1:1 0.1 M formic acid/MeOH.

10.3.9. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for between 15 seconds and 2 minutes.

10.3.10. Discard the rinses. Rinse out inside of manifold with 1% NH_4OH/Methanol

10.4. SPE Elution of Aqueous Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

10.4.1. Add the collection tubes to the manifold. Rinse sample bottles with 5 mL of 1.0% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 1% NH_4OH/methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

10.4.2. Air dry and weigh the bottles (record as the tare weight in TALS) to get the sample volume extracted.

10.4.3. Proceed to Section 10.5 for final volume.

For **DOD/DOE** samples proceed to Section 10.10.1 for loose graphitized carbon procedure.

10.5. Final volume for Aqueous Sample extracts

10.5.1. Add 25 µL of concentrated acetic acid to each sample. Cap, vortex, and set the samples aside.

10.5.2. Vortex the LC1633_NIS solution (IS solution) prior to use.

10.5.3. Add 62.5 µL of IS (Section 7.67.6) at 100-400 ng/mL concentration, into a new centrifuge tube.

10.5.4. Place a syringe filter (25 mm filter, 0.2 um nylon membrane) on a polypropylene syringe.

10.5.5. Decant the sample extract from section 10.5.1 into the polypropylene syringe fitted with a syringe filter.

10.5.6. Filter into the centrifuge tube that contains NIS from section 10.5.3.

10.5.7. Adjust final volume to 5 mL using 1.0% NH_4OH/methanol. Cap and vortex.

10.5.8. Transfer a portion of the extract to a 0.3 mL polypropylene micro vial. Archive the rest of the extract in a refrigerator for re-injection and dilution.

10.5.9. Seal the vial with a polypropylene screw or snap-top cap. Note: Teflon lined caps cannot be used due to detection of low-level concentration of PFAS. Tap down the vials prior to injection to ensure no air bubbles exist at the bottom

10.6. Solid and Biosolids Sample Preparation and Extraction

10.6.1. Visually inspect soil samples. Homogenize the entire sample in accordance with SOP DV-QA-0023 *Subsampling*. If the sample cannot be mixed in the container, pour into a larger QC'd PFAS-free container and mix thoroughly. Transfer the sample label to the new container.

10.6.2. All solid and biosolids samples must have their default mass increased by the percent moisture content prior to extraction.

10.6.2.1. Review TALS for the percent moisture results. Use the following equation to determine what adjustment is needed to the default masses listed in Section 10.6.3.

10.6.2.1.1. Dry wt. adjusted mass = default mass X (1+ percent moisture as a decimal)

NOTE: Do not add more than 10x the default mass, regardless of the percent moisture value.

10.6.3. Weigh a representative dry weight adjusted 5 g aliquot of sample (0.5 g for biosolids) into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

10.6.3.1. Do not batch solid sample and biosolids samples together due to the different masses.

10.6.4. For the method blank, LLCS and LCS matrix, use 5 g each of Ottawa sand wetted with 2.5 g of DI water or 0.5 g of Ottawa sand wetted with 250 µL of DI water for biosolids.

10.6.5. Vortex the LC1633EPALSP and LC1633_EIS solutions prior to use.

10.6.6. Add 0.250 mL of the LC1633_EIS solution (Section 7.5) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample vial.

10.6.7. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LC1633EPALSP Spike solution (Section 7.4), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

10.6.8. Spike the LLCS with 100 µL of the LC1633EPALSP Spike solution (Section 7.4), for a fixed concentration of 0.32-8.0 ng/mL in the final sample vial.

10.6.9. Cap the tubes, vortex samples and allow the spike to settle into the sample matrix for at least 30 minutes.

10.6.10. Add 10 mL of 0.3% NH_4OH/methanol to each sample. Cap and vortex.

10.6.11. Shake each sample on an orbital shaker at room temperature for 30 minutes.

10.6.12. Centrifuge each sample at 2800 rpm for 10 minutes.

10.6.13. Collect and decant the solvent into a new 50 mL tube.

10.6.14. Add 15 mL of 0.3% NH_4OH/methanol solution to the residue and vortex.

10.6.15. Shake each sample again on an orbital shaker at room temperature for 30 minutes.

10.6.16. Centrifuge each sample at 2800 rpm for 10 minutes.

10.6.17. Collect/decant the solvent into the centrifuge tube from Section 10.6.13.

10.6.18. Add 5 mL of 0.3% NH_4OH/methanol solution to the residue and vortex.

10.6.19. Centrifuge each sample at 2800 rpm for 10 minutes.

10.6.20. Collect/decant the solvent into the centrifuge tube from Section 10.6.13.

10.6.21. Add 10 mg of loose graphitized carbon to each sample and batch QC extract.

10.6.22. Hand-shake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon.

10.6.23. Immediately vortex for 30 seconds and centrifuge at 2800 rpm for 10 minutes.

10.6.24. Bring the sample up to 250 mL with reagent water. Cap and Vortex.

10.6.25. Check the pH to ensure pH is between 6.5 ± 0.5. Neutralize with 50% Formic Acid and 3% Ammonium Hydroxide and mix the contents well with vortex mixer.

10.7. Solid Phase Extraction (SPE) of Solid, and Biosolids Samples

10.7.1. Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel.

10.7.2. Condition the SPE cartridges (Section 6.8.1, Oasis Wax Cartridges) by passing the following without drying the column.

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

10.7.3. Wash with 15.0 mL of 1% NH_4OH/methanol.

10.7.4. Wash with 5.0 mL of 0.3M formic acid. Close valve when ~ 200 µL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

10.7.5. Appropriately label the columns and add the reservoir to the column. The QC samples do not need to be rotates as long a new liners and clean reservoirs as used with each batch.

10.7.6. Add samples to the columns and with vacuum, pull the entire 250 mL aliquot of the sample through the cartridge at a rate of approximately 2 to 5 drops per second.

10.7.7. After the entire sample has been loaded onto the column, rinse the centrifuge tube with two 5 mL aliquots of reagent water and pour into the column reservoir.

10.7.8. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL of 1:1 0.1M formic acid/methanol.

10.7.9. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for 15 seconds to 2 minutes. Discard the rinses.

10.8. SPE Elution of Solid and Biosolids Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

10.8.1. Vortex the LC1633_NIS solution prior to use.

10.8.2. Add 62.5 µL of LC1633_NIS (Section 7.6) at 100-400 ng/mL concentration into a new centrifuge tube.

10.8.3. Place the centrifuge tubes containing the NIS in the manifold.

10.8.4. Rinse 250 mL extract bottles with 5 mL of 1% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 1% NH_4OH/methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

10.8.5. Proceed to Section 10.9 for final volume.

10.9. Final volume for Solid and Biosolids Sample extracts

10.9.1. Add 25 µL of concentrated acetic acid to each sample. Cap, vortex, and set the samples aside.

10.9.2. Bring up the final volume to 5 mL using 1.0% NH_4OH/methanol. Cap and vortex.

10.9.3. Place a syringe filter (25 mm filter, 0.2 um nylon membrane) on a polypropylene syringe.

10.9.4. Decant the sample extract into the polypropylene syringe fitted with a syringe filter.

10.9.5. Filter the eluted sample.

10.9.6. Transfer a portion of the extract to a 0.3 mL polypropylene micro vial. Archive the rest of the extracts for re-injection and dilution.

10.9.7. Seal the vial with a polypropylene screw top cap. Note: Teflon lined caps cannot be used due to detection of low level concentration of PFAS. Tap down the vials prior to injection to ensure no air bubbles exist at the bottom

10.10. Use of Loose Graphitized Carbon (Envi-Carb)

Analyses performed in accordance with the DOD/DOE QSM Table B-24 require the use of loose graphitized carbon in place of pre-packed cartridges for cleanups. Instructions for performing this cleanup are provided below:

10.10.1. **Water** Samples: Immediately following Section 10.4 (SPE elution) add 25 µL of acetic acid to each sample eluted in the collection tubes and vortex to mix. Add 10 mg of carbon to each sample and batch QC extract.

10.10.2. Hand-shake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon.

10.10.3. Immediately vortex for 30 seconds and centrifuge at 2800 rpm for 10 minutes.

10.10.4. **Water** Samples: Proceed to Section 10.5.2.

10.11. Instrument Analysis

Suggested operating conditions are listed in Tables 10.11-1-4 for the SCIEX LCMS systems:

<table>
<tr><th colspan="5">Table 10.11 - 1
Recommended Instrument Operating Conditions</th></tr>
<tr><th colspan="5">HPLC Conditions</th></tr>
<tr><td>Column (Column temp = 45°C)</td><td colspan="4">Phenomenex Gemini 3 µm C18 110Å, 50 X 2 mm</td></tr>
<tr><td>Mobile Phase Composition</td><td colspan="4">A = 10 mM Ammonium Acetate in 95/5 Water/Acetonitrile
B = Acetonitrile</td></tr>
<tr><td rowspan="11">Gradient Program</td><td>Time</td><td>%A</td><td>%B</td><td>Flow Rate - mL/min</td></tr>
<tr><td>0</td><td>98</td><td>2</td><td>0.35</td></tr>
<tr><td>0.2</td><td>98</td><td>2</td><td>0.35</td></tr>
<tr><td>4.0</td><td>70</td><td>30</td><td>0.40</td></tr>
<tr><td>7.0</td><td>45</td><td>55</td><td>0.40</td></tr>
<tr><td>9.0</td><td>25</td><td>75</td><td>0.40</td></tr>
<tr><td>10.0</td><td>5</td><td>95</td><td>0.40</td></tr>
<tr><td>10.4</td><td>98</td><td>2</td><td>0.40</td></tr>
<tr><td>11.8</td><td>98</td><td>2</td><td>0.40</td></tr>
<tr><td>12.0</td><td>98</td><td>2</td><td>0.35</td></tr>
<tr><td colspan="4">Maximum pressure limit = 5,000 psi</td></tr>
<tr><td>Injection Size</td><td colspan="4">6 µL (fixed amount throughout the sequence).</td></tr>
<tr><td>Run Time</td><td colspan="4">~13.5 minutes</td></tr>
<tr><th colspan="5">Mass Spectrometer Interface Settings (SCIEX 5500)</th></tr>
<tr><td>MS Interface Mode</td><td colspan="4">ESI Negative Ion. Minimum of 10 scans/peak.</td></tr>
<tr><td>Ion Spray Voltage (kV)</td><td colspan="4">-4.5</td></tr>
<tr><td>Entrance Potential (V)</td><td colspan="4">5</td></tr>
<tr><td>Declustering Potential (V)</td><td colspan="4">25</td></tr>
<tr><td>Desolvation Temp</td><td colspan="4">550ºC</td></tr>
<tr><td>Curtain Gas</td><td colspan="4">35 psi</td></tr>
<tr><td>Collision Gas</td><td colspan="4">10 psi</td></tr>
</table>

Table 10.11 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
11Cl-PF3OUdS	Native Analyte	630.9	450.9	9.59
11Cl-PF3OUdS_2	Native Analyte	632.9	452.9	9.59
13C2_PFDA	NIS (Internal Standard)	515.1	470.1	7.94
13C2_PFDoA	EIS (IDA)	615.1	570	8.95
13C2_PFHxA	NIS (Internal Standard)	315.1	270	5.52
13C2_PFHxA_2	NIS (Internal Standard)	315.1	119.4	5.52

Table 10.11 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
13C2_PFTeDA	EIS (IDA)	715.2	670	9.88
13C3_HFPO-DA	EIS (IDA)	286.9	168.9	5.80
13C3_HFPO-DA_2	EIS (IDA)	286.9	184.9	5.80
13C3_PFBA	NIS (Internal Standard)	216	172	3.15
13C3_PFBS	EIS (IDA)	302.1	79.9	5.55
13C3_PFBS_2	EIS (IDA)	302.1	98.9	5.55
13C3_PFHxS	EIS (IDA)	402.1	79.9	7.02
13C3_PFHxS_2	EIS (IDA)	402.1	98.8	7.02
13C4_PFBA	EIS (IDA)	216.8	171.9	3.15
13C4_PFHpA	EIS (IDA)	367.1	322	6.21
13C4_PFOA	NIS (Internal Standard)	417.1	172	6.81
13C4_PFOS	NIS (Internal Standard)	502.8	79.9	8.22
13C4_PFOS_2	NIS (Internal Standard)	502.8	98.9	8.22
13C5_PFHxA	EIS (IDA)	318	273	5.52
13C5_PFHxA_2	EIS (IDA)	318	120.3	5.52
13C5_PFNA	NIS (Internal Standard)	468	423	7.39
13C5_PFPeA	EIS (IDA)	268.3	223	4.64
13C6_PFDA	EIS (IDA)	519.1	474.1	7.94
13C7_PFUdA	EIS (IDA)	570	525.1	8.46
13C8_PFOA	EIS (IDA)	421.1	376	6.81
13C8_PFOS	EIS (IDA)	507.1	79.9	8.22
13C8_PFOS_2	EIS (IDA)	507.1	98.9	8.22
13C8_PFOSA	EIS (IDA)	506.1	77.8	8.65
13C9_PFNA	EIS (IDA)	472.1	427	7.39
18O2_PFHxS	NIS (Internal Standard)	403	83.9	7.02
3:3 FTCA	Native Analyte	241	177	4.06
3:3 FTCA_2	Native Analyte	241	117	4.06
4:2 FTS	Native Analyte	327.1	307	5.26
4.2 FTS_2	Native Analyte	327.1	80.9	5.26
5:3 FTCA	Native Analyte	341	237.1	5.79
5:3 FTCA_2	Native Analyte	341	217	5.79
6:2 FTS	Native Analyte	427.1	407	6.53
6:2 FTS_2	Native Analyte	427.1	80.9	6.53
7:3 FTCA	Native Analyte	441	316.9	7.00
7:3 FTCA_2	Native Analyte	441	336.9	7.00
8:2 FTS	Native Analyte	527.1	507	7.65
8:2 FTS_2	Native Analyte	527.1	80.8	7.65
9Cl-PF3ONS	Native Analyte	530.8	351	8.62

Table 10.11 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
9Cl-PF3ONS_2	Native Analyte	532.8	353	8.62
d3MeFOSA	EIS (IDA)	515	219	9.69
d3-MeFOSAA	EIS (IDA)	573.2	419	7.88
d5EtFOSA	EIS (IDA)	531.1	219	10.01
d5-EtFOSAA	EIS (IDA)	589.2	419	8.11
d7N-MeFOSE	EIS (IDA)	623.2	58.9	9.55
d9N-EtFOSE	EIS (IDA)	639.2	58.9	9.86
DONA	Native Analyte	376.9	250.9	6.44
DONA_2	Native Analyte	376.9	84.8	6.44
EtFOSA	Native Analyte	526	219	10.01
EtFOSA_2	Native Analyte	526	169	10.01
HFPO-DA	Native Analyte	284.9	168.9	5.80
HFPO-DA_2	Native Analyte	284.9	184.9	5.80
M2-4:2FTS	EIS (IDA)	329.1	80.9	5.26
M2-4:2FTS_2	EIS (IDA)	329.1	309	5.26
M2-6:2FTS	EIS (IDA)	429.1	80.9	6.53
M2-6:2FTS_2	EIS (IDA)	429.1	409	6.53
M2-8:2FTS	EIS (IDA)	529.1	80.9	7.65
M2-8:2FTS_2	EIS (IDA)	529.1	509	7.65
MeFOSA	Native Analyte	511.9	219	9.69
MeFOSA_2	Native Analyte	511.9	169	9.69
N-EtFOSAA	Native Analyte	584.2	419.1	7.96
N-EtFOSAA_2	Native Analyte	584.2	526	7.96
N-EtFOSE	Native Analyte	630	58.9	9.86
NFDHA (PFECA B)	Native Analyte	295	201	5.45
NFDHA_2 (PFECA B_2)	Native Analyte	295	84.9	5.45
N-MeFOSAA	Native Analyte	570.1	419	7.75
N-MeFOSAA_2	Native Analyte	570.1	483	7.75
N-MeFOSE	Native Analyte	616.1	58.9	9.55
PFBA	Native Analyte	212.8	168.9	3.15
PFBS	Native Analyte	298.7	79.9	5.55
PFBS_2	Native Analyte	298.7	98.8	5.55
PFDA	Native Analyte	512.9	469	7.94
PFDA_2	Native Analyte	512.9	219	7.94
PFDoA	Native Analyte	613.1	569	8.95
PFDoA_2	Native Analyte	613.1	319	8.95
PFDoS	Native Analyte	699.1	79.9	10.12

Table 10.11 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
PFDoS_2	Native Analyte	699.1	98.8	10.12
PFDS	Native Analyte	599	79.9	9.22
PFDS_2	Native Analyte	599	98.8	9.22
PFEESA (PES)	Native Analyte	314.8	134.9	5.95
PFEESA_2 (PES_2)	Native Analyte	314.8	82.9	5.95
PFHpA	Native Analyte	363.1	319	6.21
PFHpA_2	Native Analyte	363.1	169	6.21
PFHpS	Native Analyte	449	79.9	7.65
PFHpS_2	Native Analyte	449	98.8	7.65
PFHxA	Native Analyte	313	269	5.52
PFHxA_2	Native Analyte	313	118.9	5.52
PFHxS	Native Analyte	398.7	79.9	6.86
PFHxS_2	Native Analyte	398.7	98.9	6.86
PFMBA (PFECA A)	Native Analyte	279	85.1	4.96
PFMPA (PFECA F)	Native Analyte	229	84.9	3.87
PFNA	Native Analyte	463	419	7.39
PFNA_2	Native Analyte	463	219	7.39
PFNS	Native Analyte	548.8	79.9	8.74
PFNS_2	Native Analyte	548.8	98.8	8.74
PFOA	Native Analyte	413	369	6.81
PFOA_2	Native Analyte	413	169	6.81
PFOS	Native Analyte	498.9	79.9	8.05
PFOS_2	Native Analyte	498.9	98.8	8.05
PFOSA	Native Analyte	498.1	77.9	8.65
PFOSA_2	Native Analyte	498.1	478	8.65
PFPeA	Native Analyte	263	219	4.64
PFPeA_2	Native Analyte	263	68.9	4.64
PFPeS	Native Analyte	349.1	79.9	6.36
PFPeS_2	Native Analyte	349.1	98.9	6.36
PFTeDA	Native Analyte	713.1	669	9.88
PFTeDA_2	Native Analyte	713.1	168.9	9.88
PFTrDA	Native Analyte	663	619	9.42
PFTrDA_2	Native Analyte	663	168.9	9.42
PFUdA	Native Analyte	563.1	519	8.46
PFUdA_2	Native Analyte	563.1	269.1	8.46
TCDA_1	Native Analyte	498.29	106.98	6.27
TCDA_2	Native Analyte	498.29	123.9	6.27
TCDA_3	Native Analyte	499.29	106.98	6.27

Table 10.11 - 2
Masses/Transitions Utilized

ID	**Comments**	**Q1**	**Q3**	**RT**
TCDA_4	Native Analyte	499.29	123.9	6.27
TCDCA	Native Analyte	464.21	126	6.11
TUDCA	Native Analyte	464.2	126	5.42

Table 10.11 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500+)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
6.27	TCDA_1	70	1	-65	-5	-58	-12
6.27	TCDA_2	70	1	-65	-5	-58	-12
6.27	TCDA_3	90	1	-65	-5	-58	-12
6.27	TCDA_4	90	1	-65	-5	-58	-12
6.11	TCDCA	120	1	-65	-5	-58	-12
5.42	TUDCA	120	1	-65	-5	-58	-12
3.15	13C3_PFBA	90	1	-25	-5	-12	-31
3.15	13C4_PFBA	90	1	-25	-5	-12	-31
3.15	PFBA	90	1	-25	-5	-12	-31
3.87	PFMPA (PFECA F)	70	1	-23	-10	-10	-16
4.06	3:3 FTCA	70	1	-46	-10	-11	-13
4.06	3:3 FTCA_2	70	1	-33	-10	-44	-15
4.64	13C5_PFPeA	80	1	-55	-7	-12	-13
4.64	PFPeA	80	1	-55	-7	-12	-13
4.64	PFPeA_2	80	1	-55	-7	-62	-15
4.96	PFMBA (PFECA A)	70	1	-5	-10	-16	-9
5.26	4.2FTS_2	70	1	-60	-10	-50	-12
5.26	4:2 FTS	70	1	-50	-7	-32	-10
5.26	M2-4:2FTS	70	1	-50	-7	-80	-10
5.26	M2-4:2FTS_2	70	1	-50	-7	-32	-10
5.55	13C3_PFBS	70	1	-55	-6	-58	-37
5.55	13C3_PFBS_2	70	1	-55	-6	-58	-37
5.45	NFDHA (PFECA B)	70	1	-35	-10	-14	-17
5.45	NFDHA_2 (PFECA B_2)	70	1	-35	-10	-34	-5
5.55	PFBS	70	1	-55	-6	-58	-37
5.55	PFBS_2	70	1	-55	-5	-40	-12
5.52	13C2_PFHxA	50	1	-55	-5	-14	-13
5.52	13C2_PFHxA_2	50	1	-55	-5	-26	-7

Table 10.11 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500+)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
5.52	13C5_PFHxA	50	1	-60	-5	-12	-15
5.52	13C5_PFHxA_2	50	1	-60	-5	-30	-9
5.52	PFHxA	50	1	-55	-5	-14	-13
5.52	PFHxA_2	50	1	-55	-5	-26	-7
5.80	13C3_HFPO-DA	70	1	-15	-10	-5	-17
5.80	13C3_HFPO-DA_2	70	1	-75	-10	-18	-15
5.80	HFPO-DA	70	1	-15	-10	-5	-17
5.80	HFPO-DA_2	70	1	-75	-10	-18	-15
5.95	PFEESA (PES)	70	1	-98	-12	-28	-12
5.95	PFEESA_2 (PES_2)	70	1	-98	-12	-28	-12
5.79	5:3 FTCA	70	1	-10	-10	-18	-13
5.79	5:3 FTCA_2	70	1	-10	-10	-38	-11
6.21	13C4_PFHpA	70	1	-25	-6	-12	-41
6.21	PFHpA	70	1	-25	-6	-12	-41
6.21	PFHpA_2	70	1	-25	-6	-20	-10
6.36	PFPeS	70	1	-57	-9	-66	-40
6.36	PFPeS_2	70	1	-57	-9	-45	-12
6.44	DONA	70	1	-55	-10	-16	-17
6.44	DONA_2	70	1	-55	-10	-35	-17
6.53	6:2 FTS	70	1	-50	-7	-32	-10
6.53	6:2 FTS_2	70	1	-80	-10	-72	-12
6.53	M2-6:2FTS	70	1	-50	-7	-90	-10
6.53	M2-6:2FTS_2	70	1	-50	-7	-32	-10
6.81	13C4_PFOA	70	1	-70	-6	-24	-31
6.81	13C8_PFOA	70	1	-70	-6	-18	-31
6.81	PFOA	70	1	-70	-6	-18	-31
6.81	PFOA_2	70	1	-70	-6	-24	-31
7.02	13C3_PFHxS	65	1	-145	-12	-88	-11
7.02	13C3_PFHxS_2	65	1	-145	-12	-80	-13
7.02	18O2_PFHxS	65	1	-145	-12	-88	-11
6.86	PFHxS	65	1	-145	-12	-88	-11
6.86	PFHxS_2	65	1	-145	-12	-80	-13
7.00	7:3 FTCA	70	1	-27	-12	-18	-10
7.00	7:3 FTCA_2	70	1	-22	-12	-31	-35
7.39	13C5_PFNA	70	1	-25	-6	-14	-48
7.39	13C9_PFNA	70	1	-25	-6	-14	-48

Table 10.11 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500+)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
7.39	PFNA	70	1	-25	-6	-14	-47
7.39	PFNA_2	70	1	-25	-6	-24	-47
7.65	PFHpS	70	1	-65	-11	-88	-46
7.65	PFHpS_2	70	1	-65	-11	-50	-12
7.65	8:2 FTS	70	1	-50	-7	-40	-15
7.65	8:2 FTS_2	70	1	-60	-10	-82	-9
7.65	M2-8:2FTS	70	1	-50	-7	-90	-15
7.65	M2-8:2FTS_2	70	1	-50	-7	-40	-15
7.94	13C2_PFDA	70	1	-25	-6	-16	-51
7.94	13C6_PFDA	70	1	-25	-6	-16	-51
7.94	PFDA	70	1	-25	-6	-16	-51
7.94	PFDA_2	70	1	-25	-6	-26	-12
7.88	d3-MeFOSAA	90	1	-40	-7	-36	-15
7.75	NMeFOSAA	90	1	-40	-7	-36	-15
7.75	NMeFOSAA_2	90	1	-75	-10	-22	-12
8.22	13C4_PFOS	90	1	-140	-9	-130	-13
8.22	13C4_PFOS_2	90	1	-140	-9	-98	-5
8.22	13C8_PFOS	90	1	-205	-9	-112	-11
8.22	13C8_PFOS_2	90	1	-205	-9	-112	-11
8.05	PFOS	90	1	-140	-9	-130	-13
8.05	PFOS_2	90	1	-140	-9	-98	-5
8.11	d5-EtFOSAA	90	1	-50	-7	-36	-15
7.96	NEtFOSAA	90	1	-50	-7	-36	-15
7.96	NEtFOSAA_2	90	1	-90	-10	-28	-12
8.62	9Cl-PF3ONS	70	1	-120	-10	-30	-17
8.62	9Cl-PF3ONS_2	70	1	-120	-10	-30	-15
8.46	13C7_PFUdA	70	1	-25	-7	-18	-54
8.46	PFUdA	70	1	-25	-7	-18	-54
8.46	PFUdA_2	70	1	-25	-7	-28	-12
8.74	PFNS	70	1	-75	-10	-113	-52
8.74	PFNS_2	70	1	-75	-8	-71	-12
8.95	13C2_PFDoA	70	1	-25	-5	-18	-54
8.95	PFDoA	70	1	-25	-5	-18	-54
8.95	PFDoA_2	70	1	-25	-5	-30	-12
8.65	13C8_PFOSA	75	1	-90	-8	-92	-11
8.65	PFOSA	75	1	-90	-8	-92	-11
8.65	PFOSA_2	75	1	-60	-10	-40	-8

Table 10.11 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500+)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
9.22	PFDS	70	1	-30	-11	-130	-11
9.22	PFDS_2	70	1	-30	-11	-110	-17
9.42	PFTrDA	90	1	-25	-7	-20	-54
9.42	PFTrDA_2	90	1	-25	-7	-36	-12
9.59	11Cl-PF3OUdS	70	1	-160	-10	-40	-17
9.59	11Cl-PF3OUdS_2	70	1	-160	-10	-40	-15
9.88	13C2_PFTeDA	120	1	-25	-7	-22	-54
9.88	PFTeDA	120	1	-25	-7	-22	-10
9.88	PFTeDA_2	120	1	-25	-7	-36	-30
10.12	PFDoS	90	1	-10	-11	-76	-11
10.12	PFDoS_2	90	1	-10	-11	-130	-5
9.55	d7N-MeFOSE	70	1	-20	-5	-70	-10
9.55	N-MeFOSE	70	1	-20	-5	-70	-10
9.69	d3MeFOSA	70	1	-75	-7	-37	-15
9.69	MeFOSA	70	1	-75	-7	-37	-15
9.69	MeFOSA_2	70	1	-50	-2	-40	-6
9.86	d9N-EtFOSE	70	1	-20	-5	-70	-10
9.86	N-EtFOSE	70	1	-20	-5	-70	-10
10.01	d5EtFOSA	70	1	-75	-7	-37	-15
10.01	EtFOSA	70	1	-75	-7	-37	-15
10.01	EtFOSA_2	70	1	-50	-8	-40	-6

Table 10.11 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	3.15	13C4_PFBA	3.15	Isotope Dilution
3:3 FTCA	4.06	13C5_PFPeA	4.64	Isotope Dilution
PFPeA	4.64	13C5_PFPeA	4.64	Isotope Dilution
PFBS	5.55	13C3-PFBS	5.55	Isotope Dilution
PFECA A (PFMBA)	4.96	13C5_PFPeA	4.64	Isotope Dilution
PES (PFEESA)	5.95	13C5_PFHxA	5.52	Isotope Dilution
PFECA B (NFDHA)	5.45	13C5_PFHxA	5.52	Isotope Dilution
4:2 FTS	5.26	13C2-4:2FTS	5.26	Isotope Dilution
PFHxA	5.52	13C5_PFHxA	5.52	Isotope Dilution
PFPeS	6.36	13C3_PFHxS	7.02	Isotope Dilution
HFPO-DA	5.80	13C3_HFPO-DA	5.80	Isotope Dilution
5:3 FTCA	5.79	13C5_PFHxA	5.52	Isotope Dilution

Table 10.11 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFECA_F (PFMPA)	3.87	13C5_PFPeA	4.64	Isotope Dilution
PFHpA	6.21	13C4_PFHpA	6.21	Isotope Dilution
PFHxS	6.86	13C3_PFHxS	7.02	Isotope Dilution
DONA	6.44	13C3_HFPO-DA	5.80	Isotope Dilution
6:2 FTS	6.53	13C2-6:2FTS	6.53	Isotope Dilution
PFOA	6.81	13C8_PFOA	6.81	Isotope Dilution
PFHpS	7.65	13C8_PFOS	8.22	Isotope Dilution
7:3 FTCA	7.00	13C5_PFHxA	5.52	Isotope Dilution
PFOS	8.05	13C8_PFOS	8.22	Isotope Dilution
PFNA	7.39	13C9_PFNA	7.39	Isotope Dilution
9Cl-PF3ONS	8.62	13C3_HFPO-DA	5.80	Isotope Dilution
PFOSA	8.65	13C8_PFOSA	8.65	Isotope Dilution
PFNS	8.74	13C8_PFOS	8.22	Isotope Dilution
PFDA	7.94	13C6_PFDA	7.94	Isotope Dilution
8:2 FTS	7.65	13C2-8:2FTS	7.65	Isotope Dilution
NMeFOSAA	7.75	d3-MeFOSAA	7.88	Isotope Dilution
PFDS	9.22	13C8_PFOS	8.22	Isotope Dilution
PFUdA (PFUnA)	8.46	13C7_PFUdA	8.46	Isotope Dilution
NEtFOSAA	7.96	d5-EtFOSAA	8.11	Isotope Dilution
N-MeFOSE	9.55	d7N-MeFOSE	9.55	Isotope Dilution
MeFOSA	9.69	d3MeFOSA	9.69	Isotope Dilution
11Cl-PF3OUdS	9.59	13C3_HFPO-DA	5.80	Isotope Dilution
N-EtFOSE	9.86	d9N-EtFOSE	9.86	Isotope Dilution
EtFOSA	10.01	d5EtFOSA	10.01	Isotope Dilution
PFDoA	8.95	13C2_PFDoA	8.95	Isotope Dilution
PFDoS	10.12	13C8_PFOS	8.22	Isotope Dilution
PFTrDA	9.42	13C2_PFDoA	8.95	Isotope Dilution
PFTeDA	9.88	13C2_PFTeDA	9.88	Isotope Dilution

10.11.1. Tune and calibrate the instrument as described in Section 10.

10.11.2. A typical run sequence is as follows:

- Wash instrument with 98%B at 0.35 mL/min
- Equilibrate at 2%B at 0.35 mL/min and monitor back pressure
- Rinse Blank (RB, not linked to anything)
- CCVL (referred to as an ISC in Method 1633)
- Qualitative verification standard (Technical Standard can be combined with bile salt interference check)
- Rinse Blank (RB, not linked to anything)
- Method blank
- LLCS

- LCS
- 10 samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- CCB
- 10 more samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- CCB
- Etc.
- At the end of the analysis batch, flush the system with >95%B to remove salt build-up.

10.12. Vortex all sample aliquots and standards prior to placing on the autosampler. Make sure there are no bubbles at the bottom on the conical vials.

10.13. Samples analyzed subsequent to any sample with results at or above the upper calibration limit must be evaluated for potential carryover, and corrective actions taken, as detailed below.

10.13.1. If carryover is suspected, those samples are to be re-analyzed from a fresh extract aliquot (i.e. go the archive of the extract).

10.13.2. Should there be instrument contamination, as evident by sample carryover, any sample >5X the UCL or instrument blanks with detections > RL:

- Analyze 20 blanks alternating between 1% formic acid/methanol and 1% formic acid/water.
- Then analyze 3 methanol only blanks.
- If the system is clean resume analyses. Proceed to 10.13.4. If not clean, proceed as directed below.

10.13.3. If the system is still contaminated the following items might need to be cleaned or replaced:

- Reverse flush the analytical column
- Reverse flush the isolation column
- Replace the column (isolation, analytical or both)
- Clean the cones/entry port
- Replace the PEEK tubing in the sample pathway
- Then, repeat 10.13.2.

10.13.4. Should a high-level sample be analyzed that triggers these steps then detections for those analytes over the next 2-3 days require additional evaluation (are all instrument blanks from the sequence < ½ RL) and possible re-analysis. If sample results replicate and the associated instrument blanks from the sequences are <1/2 RL then one can assume the system is under control and confirmation of positive detections can stop.

11. Calibration

11.1. For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations, refer to NDSC-QA-QP44940 *Calibration Curves and Selection of Calibration Points*.

11.2. Routine instrument operating conditions are listed in the table in Section 6.21.

11.3. Instrument Tuning & Mass Calibration

11.3.1. Mass Calibration is performed by instrument manufacturer service representatives in accordance with the manufacturer's procedures during installation, and annually thereafter.

11.3.2. Instrument tuning is done initially when the method is first developed and thereafter as needed during troubleshooting. Tuning is done by infusing each individual compound (native and/or IDA) into the mobile phase using a tee fitting at a point just before the entrance to the electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and updated as needed. The mass assignments must be within ± 0.2 amu of the values shown in the table in Section 10.11.

11.3.3. Once the optimal mass assignments (within ±0.2 amu of true) are made immediately following the initial tune, the lowest level standard from the initial calibration curve is assessed to ensure that a signal to noise ratio greater than 10 to 1 (S/N > 10:1) is achieved for each PFAS analyte. The first level standard from the initial calibration curve is used to evaluate the tune stability on an ongoing basis. The instrument mass windows are set initially at ± 0.2 amu of the true value; therefore, continued detection of the analyte transition with S/N > 10:1 serves as verification that the assigned mass remains within approximately ± 0.2 amu of the true value, which meets the tune criterion.

11.3.3.1. The instrument must have a valid mass calibration prior to sample analysis. This is verified through the acquisition of a full scan continuum mass spectrum of a PFAS stock standard. All masses must be verified to be within ± 0.2 amu of true value.

11.4. A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include, but are not limited to, new columns or pump seals. A new calibration is not required after minor maintenance.

11.5. With the exception of the circumstances delineated in policy NDSC-QA-QP44940 *Calibration Curves and Selection of Calibration Points*, it is not acceptable to remove points from a calibration curve. In any event, at least five points must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points.

11.6. A fixed injection volume is used for quantitation purposes and is to be the same for both the sample and standards.

11.7. All units used in the calculations must be consistently uniform, such as concentration in ng/mL.

11.8. Initial Calibration

Refer to Section 12.4.2 for details relating to setting retention times and evaluating retention times.

11.8.1. A number of analytical standards of different analyte concentrations are used to generate the curve. Each standard is injected once to obtain the peak response for each analyte at each concentration. These standards define the working range of the analysis.

11.8.1.1. A minimum of six analytical standards is used when using average response factor and/or linear calibration fits, five of which must be ≥ RL.

11.8.1.2. A minimum of seven analytical standards is used when a quadratic fit is used to generate the curve, six of which must be ≥ RL.

11.8.2. Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used for the analyte if the response is non-linear.

11.8.2.1. For average response factor (RFa), the relative standard deviation (RSD) for all compounds must be ≤ 20% for the curve to be valid.

11.8.2.2. Alternatively, for curve types including linear, quadratic, weighted or unweighted, the relative standard error (RSE) for all compounds must be ≤ 20% for the curve to be valid.

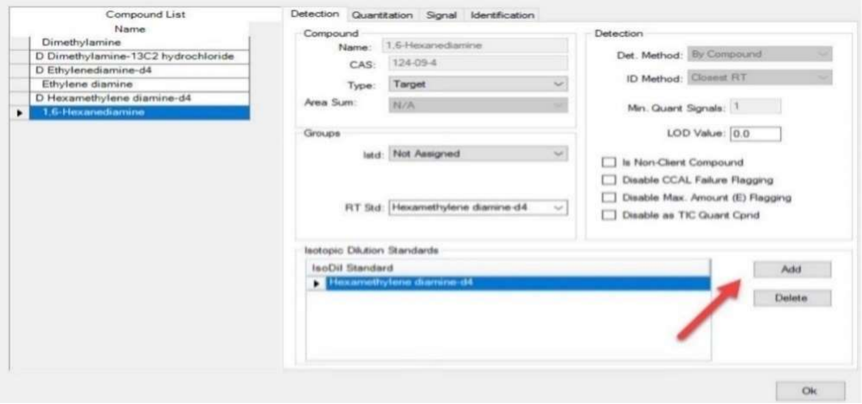
11.8.2.3. For linear fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

11.8.2.4. For quadratic fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

11.8.2.5. While not required by the method, the analyte readback should be 70-130% of the true value.

11.8.2.6. Please note for this method PFTrDA is quantitated against the average areas of the IDA 13C2-PFTeDA and 13C2-PFDoA. In order to set this quantitation up correctly in Chrom be certain to update the analyte PFTrDA per the example below (Figure 11.8.2.5).

Figure 11.8.2.5



Compound List

Name

- Dimethylamine
- D Dimethylamine-13C2 hydrochloride
- D Ethylenediamine-d4
- Ethylene diamine
- D Hexamethylene diamine-d4
- 1,6-Hexanediamine

Compound

Name: 1,6-Hexanediamine
CAS: 124-09-4
Type: Target
Area Sum: N/A

Groups

Istd: Not Assigned
RT Std: Hexamethylene diamine-d4

Detection

Det. Method: By Compound
ID Method: Closest RT
Min. Quant Signals: 1
LOD Value: 0.0

☐ Is Non-Client Compound
☐ Disable CCAL Failure Flagging
☐ Disable Max. Amount (E) Flagging
☐ Disable as TIC Quant Cpnd

Isotopic Dilution Standards

IsoDil Standard
Hexamethylene diamine-d4

11.9. Calibration Curve Fits

11.9.1. Linear regression or quadratic curves may be used to fit the data to a calibration function. Detailed descriptions and formulas for each fitting type can be found in NDSC-QA-QP44940.

11.9.2. The Chrom data system is programmed to complement the calibration evaluation guidelines in policy NDSC-QA-QP44940 by evaluating calibration curve fits in the order listed below. An optimal fit is recommended to the analyst, who may override based on evaluation of the residuals for each calibration level, as per policy NDSC-QA-QP44940.

- Average Response Factor
- Linear, 1/concentration^2 weighting
- Linear, 1/concentration weighting, forced through zero
- Quadratic, 1/concentration^2 weighting

11.9.3. The linear curve uses the following function:

Equation 3

$$y = bx + c$$

Where:

$$y = \frac{Area\ (Analyte)}{Area\ (IDA)} \times Concentration(IDA)$$

x = concentration
b = slope
c = intercept

11.9.4. The quadratic curve uses the following function:

Equation 4

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

11.9.5. The functions for the linear 1/concentration weighting and linear 1/concentration^2 weighting curves can be found in the NDSC-QA-QP44940, Section 7.

11.9.5.1. Linear 1/concentration weighting, forced through zero

$S^2 = \sum \frac{1}{x}(C_1 x + C_0 - y)^2$ Weighted sum of squares

Regression equations:

$$\sum y = C_1 \sum x + n\, C_0$$

$$\sum y/x = n\, C_1 + C_0 \sum 1/x$$

Equation 5 Slope = C_1 $C_1 = \frac{R_1}{R} = \frac{n \sum {}^{y}/_{x} - (\sum y)\,(\sum 1/x)}{n^2 - (\sum x)\,(\sum 1/x)}$

Equation 6 Y- intercept = C_0 0

11.9.5.2 Linear 1/concentration^2 weighting, not forced through zero

$S^2 = \sum \frac{1}{x^2}(C_1 x + C_0 - y)^2$ Weighted sum of squares

Regression equations:

$$\sum \frac{y}{x} = (C_0 \sum \frac{1}{x}) + n\, C_1$$

$$\sum \frac{y}{x^2} = C_0 \sum \frac{1}{x^2} + C_1 \sum \frac{1}{x}$$

Equation 7 Slope = C_1 $C_1 = \frac{R_1}{R} = \frac{(\sum\frac{1}{x})\,(\sum\frac{y}{x^2}) - (\sum\frac{y}{x})\,(\sum\frac{1}{x^2})}{(\sum\frac{1}{x})^2 - (\sum\frac{1}{x^2})n}$

Equation 8 Y- intercept = C_0 $C_0 = \frac{R_0}{R} = \frac{\left(\sum\frac{y}{x}\right)\left(\sum\frac{1}{x}\right) - n\sum\frac{y}{x^2}}{(\sum\frac{1}{x})^2 - (\sum\frac{1}{x^2})\,n}$

11.9.6. Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

- The signal to noise ratio for each analyte with quantifier/qualifier ions must be ≥ 3:1 in the lowest calibration standard for that component. For analytes with a quantifier ion only, the signal to noise ratio must be ≥ 10:1 in the lowest calibration standard.
- Response must increase with increasing concentration.
- The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.
- There should be no carryover at or above 1/2 MRL after a high ICAL standard.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

11.9.7. Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration^2 or 1/x^2 weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

11.9.8. Bile Salts Interference Check

The laboratory must analyze a bile salts standard (TDCA, {TCDA and TUDCA only if the eluent is not acetonitrile}) after the initial calibration, prior to the analysis of samples and any time when DoD samples are analyzed, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference of TDCA (e.g. changing the retention time of TDCA such that it falls outside the retention time window for PFOS by more than 60 seconds with baseline resolution), and the initial calibration is repeated.

11.9.8.1. The check is required daily for all matrices when analyzing DoD/DOE QSM samples.

11.10. Initial Calibration Blank (ICB)

11.10.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of final extract solvent containing both IDA and IS.

11.10.2. The result for the calibration blank must be less than the MDL.

11.10.3. If the ICB is greater than the MDL then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

11.11. Initial Calibration Verification (ICV)

11.11.1. Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

11.11.2. The recovery for the ICV must be equal to or within 70-130% for all natives and IDA.

11.11.3. See Section 9.11 for corrective actions in the event that the ICV does not meet the criteria above.

11.12. Continuing Calibration Verification (CCV)

Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are at the mid-level range of the curve. The curve and ICV do not need to be run every day. To start an analytical sequence on days when an

ICAL is not performed, a CCVL (low standard at the RL) is analyzed and if it meets acceptance criteria a run can be started.

11.12.1. The recovery for the CCV standards must be equal to or within 70-130% for all natives and IDA.

11.12.2. If the analyte in a CCV fails due to a high recovery, but that analyte is not detected in the sample extract, then the sample can be reported with an NCM stating the high bias and sample is ND.

11.12.3. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

12. Calculations / Data Reduction

12.1. If the concentration of the analyte ions exceeds the working range as defined by the calibration standards, then the sample might require to be diluted and reanalyzed, based upon client need. It may be necessary to dilute samples due to matrix.

Dilute a subsample of the sample extract with methanolic ammonium hydroxide and acetic acid solution from Section 7.1.13 by a factor no greater than 10x and analyze the diluted extract.

12.2. Extracts can be diluted up to no more than 10X without diluting out the IDA, in most cases, and thus preserving quantitation via isotope dilution. IDA recovery must be >5% in the dilution. Use the IDA recoveries in the undiluted analysis to select the dilution factor, with the objective of keeping the IDA recoveries in the dilution above the 5% lower limit.

12.2.1. For example, if the IDA recovery for the affected analyte in the undiluted analysis is 50%, then the extract cannot be diluted more than 10X. If the IDA recovery of the affected analyte in the undiluted analysis is 30%, then the extract cannot be diluted more than 6X.

12.2.2. If the IDA response in the dilution is < 10:1 signal to noise or RT is off then the sample is to be re-extracted at a smaller aliquot.

12.2.3. If a dilution greater than 10X is needed, then the sample should be re-extracted at a smaller aliquot.

12.2.4. If a dilution is required, report the 1X data, including IDA, as primary data, and analyte of interest and associated IDA only from the dilution as secondary data.

12.2.5. If the response of the IDA in the diluted extract meets the S/N and retention time requirements and the IDA recovery is > 5%, then the compounds associated with the IDA can be used to quantify the target analytes

12.2.6. If the IDA recovery in the diluted extract does not met the requirements, then the compound cannot be measured by isotope dilution. The laboratory must take a smaller aliquot of the aqueous sample and dilute it to 500 mL with reagent water or smaller aliquot of solid sample and re-extract. Adjust compound concentration and detection limit to account for dilution.

12.3. Results less than the reporting limit are flagged in the client report as estimated. Generally, the “J” flag is used to denote ≥ MDL and ≤ RL, but the specific flag may change based on client requirements.

12.4. Qualitative Identification

12.4.1. The retention times of PFAS with labeled standards should be the same as that of the labeled IDA’s to within 0.1 min. For PFAS with no labeled standards, the RT must be within ± 0.4 minutes of the ICAL or the most recent CCV standard.

Note: The IDA RT and native RT may be offset by 0.02 to 0.04 minutes.

PFBS, PFHxS, PFOS, Me-FOSAA, and Et-FOSAA have multiple chromatographic peaks using the LC conditions specified in the method due to the linear and branch isomers of these compounds. Most PFAS compounds are manufactured by one of two processes, ECF or fluorotelomerization. One gives rise to linear PFAS only while the other process produces both linear and branched isomers. Both branched and linear PFAS compounds can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in the sample must be integrated in the same way as the calibration standard and concentrations reported as a total for each of these analytes.

12.4.2. The expected retention times (RT) are established in the Chrom data processing module during the processing of the ICAL by selecting Edit>Method>Update RT. Once the retention times are established Chrom will look for a peak within ± 0.25 minutes of the RT. The analyst confirms that the branched isomers present in the quantitative calibration standards for PFOS, PFHxS, Et-FOSAA and Me-FOSAA are within the ± 0.25 minute window. If they are not, an adjustment to the RT window is made. The analyst confirms the presence of the branched isomers in the technical (qualitative) standard as well and adjusts the RT window for an analyte if it is not present within the ± 0.25 minute window.

12.4.2.1. If a peak is detected within this window of ±0.25 minutes, Chrom will assign the absolute retention time at the apex of the peak. Chrom assigns the RT to the most predominant peak within this window. As the linear peak is the predominant peak in calibration solutions for those PFAS that are calibrated with the combination of both branched and linear isomers, those PFAS require additional evaluation in the event that the branched isomer is the predominant peak in a field sample and Chrom has not positively identified the peak due to the RT shift, as the apex may now be the branched isomer.

12.4.2.2. Additional evaluation is required if the field samples contain branched isomers not present in the quantitative or qualitative standards. The analyst confirms that only the peaks present in the calibration standards are included in the peak integration, or adjusts the peak integration to assure that only the peaks present in the standards are identified and quantitated.

12.4.2.3. RT are updated as needed based upon evaluation of the daily CCV.

12.4.3. The signal to noise ratio for both quantitative and qualitative ions/transitions must be ≥ 3:1 or > 10:1 if the analyte only has a single transition for a baseline deflection to be considered a peak. If this criterion is not met, the analyte is not considered and reported as “non-detect”.

12.5. The ICAL established in Section 11 is used to calculate concentrations for the extracts.

12.6. Extract concentrations are calculated as below. The first equation applies Average Response Factor model, the second to a linear fit, and the third to the quadratic line fit.

Equation 9

$$Concentration\ (ng/mL) = \frac{y}{RRF}$$

Equation 10

$$Concentration\ (ng/mL) = \frac{y-c}{b}$$

Equation 11

$$Concentration\ (ng/mL) = \frac{-b \pm \sqrt{b^2-4ac-}}{2a}$$

Where:

y = $\frac{Area_{Target}}{Area_{IDA}} \times Concentration(IDA)$
RRF = Relative Response Factor
x = concentration
a = curvature
b = slope
c = intercept

12.7. Water Sample Result Calculation:

Equation 12

$$Concentration\ (ng/L) = \frac{C_{ex}V_t}{V_0}$$

Where:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
V_o = Volume of water extracted (L), i.e. total volume fortified with IDA

12.8. Soil Sample Result Calculation:

Equation 13

$$Concentration\ (ng/g) = \frac{C_{ex}V_t}{W_s D}$$

Where ng/g = µg/kg and:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
W_s = Weight of sample extracted (g)
D = Fraction of dry solids, which is calculated as follows:

$$\frac{100 - \%\ moisture\ in\ samp}{100}$$ (for dry weight result)

12.9. IDA Recovery Calculation:

Equation 14

$$\%\ Recovery = \frac{A_{IDA}Q_{IS}}{A_{IS}Q_{IDA}RRF_{IDA}} \times 100$$

Where:

RRF_{IDA} = Response Factor for IDA compound
A_{IDA} = Area response for IDA compound
A_{IS} = Area Response for IS compound
Q_{IS} = Amount of IS added
Q_{IDA} = Amount of IDA added

12.10. Raw data, calibration summaries, QC data, and sample results are reviewed by the analyst. These must also be reviewed thoroughly by a second qualified person. See the Data Review Policy (DV-QA-0020). These reviews are documented in TALS.

13. Method Performance

13.1. The group/team leader has the responsibility to ensure that this procedure is performed by an associate who has been properly trained in its use and has the required expertise.

13.2. Method Detection Limit

The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in SOP NDSC-QA-SOP-42091 “Detection and Quantitation Limits” and policy DV-QA-003P *Quality Control Program*. MDLs are available in the Quality Assurance Department.

13.3. Initial Demonstration of Capability (IDOC)

13.3.1. The method initial demonstration of capability is performed by processing 4 LCS samples and a method blank. Compare the average recovery and RSD to the IPR limits in Table 5 of the reference method.

13.3.2. Each analyst performing this procedure must successfully analyze four LCS QC samples using current laboratory LCS control limits in the LIMS. IDOCs are approved by the Quality Assurance Manager and the Technical Director. IDOC records are maintained by the QA staff in the central training files.

14. Pollution Prevention

14.1. All waste will be disposed of in accordance with Federal, State and Local regulations.

14.2. Solid phase extraction used for water samples greatly reduces the amount of solvent used compared to liquid-liquid extraction.

14.3. Standards and reagents are purchased and prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.4. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in Section 13 of the NDSC Safety Manual for “Waste Management and Pollution Prevention.”

14.5. Do not allow waste solvent to vent into the hoods. All solvent waste is stored in capped containers unless waste is being transferred.

14.6. Transfer waste solvent from collection cups (tri-pour and similar containers) to jugs and/or carboys as quickly as possible to minimize evaporation.

15. Waste Management

The following waste streams are produced when this method is carried out:

15.1. All waste will be disposed of in accordance with Federal, State, and local regulations. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this procedure, the policies in the Environmental Health and Safety Manual, and DV-HS-001P *Waste Management Plan.*

15.2. The following waste streams are produced when this method is carried out:

15.2.1. Methanol waste – Flammable Solvent (C)

15.2.2. Water Samples, post extraction and all other aqueous waste generated by this procedure is collected and turned into the Waste Coordinator for incineration under waste stream PFOA.

15.2.3. Soil samples, post extraction and all other solid waste generate by this procedure such as disposable pipette tips and extraction bottles are collected and turned into the Waste coordinator for incineration under waste stream PFOA.

15.2.4. Vial waste – Collect in PFC waste containers

15.2.5. Instrument process waste – Flammable Solvent (C)

15.2.6. Expired Chemicals/Reagents/Standards – Contact Waste Coordinator.

NOTE: Radioactive and potentially radioactive or mixed waste must be segregated from non-radioactive waste as appropriate. Contact the Waste Coordinator for proper management of radioactive or potentially radioactive waste generated by this procedure.

16. References

16.1. Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, August 2021.

16.2. 2nd Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, June 2022.

16.3. 3rd Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, December 2022.

17. Method Modifications

17.1. Modifications from Method 1633 are detailed below:

17.1.1. An SPE cartridge with 200 mg of WAX and 50 mg of carbon is used for water extraction and solid matrices clean up. As a result solvents and elution procedures are different.

17.1.2. The CCVL (ISC) will be used to start the analytical sequence on non-ICAL days and is to meet both S/N (3:1 or 10:1) and CCV acceptance criteria.

17.1.3. The corrective action to be taken in the event of clogging occurring in the SPE columns that is described in Section 10.3.6.1 is in lieu of using a second SPE cartridge as described in the reference method unless required by a client.

17.1.4. Immediately following the loading of aqueous samples onto the SPE columns, sample bottles are rinsed with reagent water, and the reagent water added to the column reservoir. This step is addition to the basic methanol rinse as part of the SPE elution step.

17.1.5. 10 mM Ammonium acetate in 95/5 Water/Acetonitrile is used for the aqueous mobile phase. Since the laboratory is at elevation (5,344 ft/1629 m), ammonium acetate, a volatile buffer, volatilizes at a faster rate which leads to unstable retention times PFCAs and PFSAs.

17.1.6. Percent solids in aqueous samples is determined by visual comparison to a reference sample that contains 50 mg of solid material (carbon). If samples are more turbid the extracted volume is reduced or the sample is processed as a solid based upon consultation with the client.

17.1.7. Remove N2 Blow down set, instead bring sample volume to 250 mL prior to SPE Extraction

18. ATTACHMENTS

Attachment 1: Splitting biphasic samples (by client request only)

19. REVISION HISTORY

This section has been added beginning with Revision 0. Only details of the last two revisions are incorporated into this SOP. Prior revisions are documented in the QA files and available upon request.

- Revision 1, dated 24 May 2023
    - Updated entire document to reflect the 3rd draft of EPA Method 1633
    - Change IDA to EIS throughout the document
    - Table 1.1 updated compound names for consistency
    - Table 1.2 & Table 8 updated sample matrix, sample size, and holding time requirements
    - Added additional branched isomers to Section 4.5, 7.2.2
    - Added use of filtering syringe
    - Removed average weight of bottles in section 6.3
    - Section 6.0, 6.8.2: Updated cartridge information, Added vacuum (6.12), oven (6.18), pre-weighted filters (6.19), HPLC information (6.20), maintenance schedule (6.21)
    - Section 7.1.5 updated formic acid use for clarity
    - Section 7.2.1 added expiration date of 1 year for stocks and working solutions.
    - Section 7.7.2 Qualitative standards reduced to PFOA and PFNA only. Other analytes are incorporated in the calibration solution.
    - Updated stock and working solutions in sections 7.3 through 7.7
    - Table 8. Added statement regarding samples between 3-30% solids
    - Section 8.3 added section regarding TSS screening and procedures
    - Section 9.4.1.6, batch QC does not need to be rotated if new liners and clean reservoirs are used.
    - Section 9.5.1 & 9.6.1 reference to 3rd Draft
    - Section 9.7 added laboratory duplicate criteria
    - Section 9.9 added criteria for LCSD if MS/MSD or Du are not present.
    - Section 9.13: added transition for PFPeA
    - Section 9.14.1 updated NIS criteria per the 3rd draft
    - Section 10:
    - Water extraction: added TSS criteria (10.2.1), screening criteria (10.2.2), bottle type (10.2.3.1), moved pH check before sample spiking (10.2.5), spike names/references (10.2.7-10), glass wool (10.3.1), HPLC water (10.3.4), batch qc position in manifold (10.3.5), clog flow rate (10.3.6), dry cartridge time (10.3.9), air bubbles (10.5.9)
    - Solid extraction: sample volume adjustment due to failing QC (10.6.2.1), spike names/references (10.6.5-8), moved graphitized carbon extraction (10.6.20-23), bring sample volume to 250 mL prior to SPE (10.6.24), batch qc position in manifold (10.7.5), dry cartridge time (10.7.9)
    - Instrument analysis: injection volume (10.11), flush after run (10.11)
    - Updated CE for PFOA (Table 10.11-3)
    - Section 11: %RSE is used for linear, quadratic, weighted or unweighted regressions (11.8.2.2), read-back optional (11.8.2.5), signal-to-noise for quantifier ion only (11.9.6, 12.4.3), bile acids and acetonitrile only (11.9.8), instrument blank < MDL (11.10.3)
    - Added draft 3 to references (16.3)

- Revision 1, dated 14 October 2022
    - Changed Eurofins TestAmerica to Eurofins Denver throughout.
    - Updated section 11.9.5 to include weighting equations 4 through 7.
    - Updated Table 8 to include footnote.
    - Section 11.2 updated table to Section 6.18.
    - Section 11.3.2 updated mass resolution to 0.2 amu.
    - Section 11.3.3 updated mass resolution to 0.2 amu.
    - Updated section 11.3.2 to refer to table in section 10.11.
    - Updated Tables in section 10.11 to rename table from 10.12 to 10.11.

ATTACHMENT 1:
SPLITTING BIPHASIC SAMPLES (BY CLIENT REQUEST ONLY)

Samples that contain 3-30% solids may require splitting prior to analysis. Check with the PM on which matrix to extract per the client request. If both matrices require extraction, the sample will be split first, then spiked with EIS and extracted. The client shall provide two Client Sample IDs.

1. Weight the whole bottle and record the weight directly onto the bottle. Using the Login module, add an NCM ("Other- Observation") that states sample was split into aqueous and solid fraction and record the initial whole bottle weight.
2. Centrifuge the whole bottle for 20 minutes at 35% using the large buckets that hold 500 mL bottles
3. Label a clean new 500 mL HPDE bottle with the Aqueous Sample ID
4. Carefully decant the aqueous layer from the solid in the bottle. Write the whole bottle weight onto the new 500 mL bottle.
5. If analyzing aqueous, check that the sample is logged for 1633_DRAFT_TSS and 1633_SPE
    a. Record the weight of the aqueous only fraction in TALS as a NCM. Do not adjust the volume.
6. If analyzing solids, check that the sample is logged for %Moisture and 1633_Shake
    a. Leave remaining volume in original container.
7. Proceed with **Section 10.2** for water extraction or **Section 10.6** for biosolid extraction.

Title: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), SW846 Methods 8270E

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1.0 Scope and Application

1.1 Analytes, Matrix(s), and Reporting Limits

USEPA Method 8270E is an analytical method which employs the use of GC/MS to determine the concentration of semivolatile organic compounds in extracts prepared from many types of solid waste matrices, soils, and water samples

Eurofins Edison has the capability to analyze and report the compounds listed in Table 1 via Method 8270E.

Table 1

Compound	CAS No.	Compound	CAS No.
1,1'-Biphenyl	92-52-4	Anthracene **(1)**	120-12-7
1,2,4,5-Tetrachlorobenzene	95-94-3	Atrazine	1912-24-9
1,2,4-Trichlorobenzene	120-82-1	Benzaldehyde	100-52-7
1,2-Dichlorobenzene	95-50-1	Benzidine	92-87-5
1,2-Diphenylhydrazine	122-66-7	Benzo[a]anthracene **(1)**	56-55-3
1,3-Dichlorobenzene	541-73-1	Benzo[a]pyrene **(1)**	50-32-8
1,3-Dimethylnaphthalene	575-41-7	Benzo[b]fluoranthene **(1)**	205-99-2
1,4-Dichlorobenzene	106-46-7	Benzo[g,h,i]perylene **(1)**	191-24-2
1,4-Dichlorobenzene-d4 **(ISTD)**	3855-82-1	Benzo[k]fluoranthene **(1)**	207-08-9
1,4-Dioxane **(1) (2)**	123-91-1	Benzoic acid	65-85-0
1-Methylnaphthalene	90-12-0	Benzyl alcohol	100-51-6
1-Naphthylamine	134-32-7	Bis(2-chloroethoxy)methane	111-91-1
2,2'-oxybis[1-chloropropane]	108-60-1	Bis(2-chloroethyl)ether **(1)**	111-44-4
2,3,4,6-Tetrachlorophenol	58-90-2	Bis(2-ethylhexyl) phthalate	117-81-7
2,3,7,8-TCDD	1746-01-6	Bisphenol-A	80-05-7
2,3-Dihydroindene	496-11-7	Butyl benzyl phthalate	85-68-7
2,3-Dimethylaniline	87-59-2	Caprolactam	105-60-2
2,4,5-Trichlorophenol	95-95-4	Carbamazepine	298-46-4
2,4,5-Trimethylaniline	137-17-7	Carbazole	86-74-8
2,4,6-Tribromophenol **(Surrogate)**	118-79-6	Chrysene **(1)**	218-01-9
2,4,6-Trichlorophenol	88-06-2	Chrysene-d12 **(ISTD)**	1719-03-5
2,4-Dichlorophenol	120-83-2	Coumarin	91-64-5
2,4-Dimethylphenol	105-67-9	Dibenz(a,h)anthracene **(1)**	53-70-3
2,4-Dinitrophenol	51-28-5	Dibenzofuran	132-64-9
2,4-Dinitrotoluene	121-14-2	Diethyl phthalate	84-66-2
2,4-Xylidine	95-68-1	Dimethyl phthalate	131-11-3
2,6-Dinitrotoluene	606-20-2	Di-n-butyl phthalate	84-74-2
2-Chloronaphthalene	91-58-7	Di-n-octyl phthalate	117-84-0
2-Chlorophenol	95-57-8	Fluoranthene **(1)**	206-44-0
2-Ethylaniline	578-54-1	Fluorene **(1)**	86-73-7
2-Fluorobiphenyl **(Surrogate)**	321-60-8	Hexachlorobenzene **(1)**	118-74-1
2-Fluorophenol **(Surrogate)**	367-12-4	Hexachlorobutadiene	87-68-3
2-Methylnaphthalene	91-57-6	Hexachlorocyclopentadiene	77-47-4
2-Methylphenol	95-48-7	Hexachloroethane	67-72-1
2-Naphthylamine	91-59-8	Indeno[1,2,3-cd]pyrene **(1)**	193-39-5
2-Nitroaniline	88-74-4	Isophorone	78-59-1
2-Nitrophenol	88-75-5	n,n'-Dimethylaniline	121-69-7
2-tertbutyl-4-methylphenol	2409-55-4	Naphthalene **(1)**	91-20-3
2-Toluidine	95-53-4	Naphthalene-d8 **(ISTD)**	1146-65-2

Table 1

Compound	CAS No.	Compound	CAS No.
3 & 4 Methylphenol	15831-10-4	n-Decane	124-18-5
3,3'-Dichlorobenzidine	91-94-1	Nitrobenzene	98-95-3
3,4-Dimethylaniline	95-64-7	Nitrobenzene-d5 **(Surrogate)**	4165-60-0
3,5-di-tert-butyl-4-hydroxytol	128-37-0	N-Nitrosodimethylamine **(1)**	62-75-9
3-Nitroaniline	99-09-2	N-Nitrosodi-n-propylamine	621-64-7
4,6-Dinitro-2-methylphenol **(1)**	534-52-1	N-Nitrosodiphenylamine	86-30-6
4-Bromophenyl phenyl ether	101-55-3	n-Octadecane	593-45-3
4-chloro-2-methylaniline	95-69-2	o-Toluidine-d9 **(Surrogate)**	194423-47-7
4-Chloro-3-methylphenol	59-50-7	Pentachloronitrobenzene	82-68-8
4-Chloroaniline	106-47-8	Pentachlorophenol **(1)**	87-86-5
4-Chloroaniline–d4 **(Surrogate)**	191656-33-4	Perylene-d12 **(ISTD)**	1520-96-3
4-Chlorophenyl phenyl ether	7005-72-3	Phenanthrene **(1)**	85-01-8
4-Methylphenol	106-44-5	Phenanthrene-d10 **(ISTD)**	1517-22-2
4-Nitroaniline	100-01-6	Phenol	108-95-2
4-Nitrophenol	100-02-7	Phenol-d5 **(Surrogate)**	4165-62-2
Acenaphthene **(1)**	83-32-9	Phenyl ether	101-84-8
Acenaphthene-d10 **(ISTD)**	15067-26-2	Pyrene **(1)**	129-00-0
Acenaphthylene **(1)**	208-96-8	Pyridine	110-86-1
Acetophenone	98-86-2	Terphenyl-d14 **(Surrogate)**	1718-51-0
Aniline	62-53-3	Total Cresols	STL00160
Aniline-d5 **(Surrogate)**	4165-61-1		

(1) Compound can be analyzed by full scan or Selected Ion Monitoring (SIM).
(2) Compound can also be analyzed by Isotope Dilution/SIM.

1.2 For a listing of method detection limits (MDLs) and Reporting Limits (RLs) please refer to the currently active Method 8270 Method Limit Groups in TALS (Eurofins LIMS).

1.3 On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Section 7 (*Review of Work)*, and Section 19 (*Test Methods and Method Validation)* in Eurofins Edison's Quality Assurance Manual (Eurofins Edison Document No. ED-QA-LQM).

1.4 Any variation in procedure shall be completely documented using an NCM. The NCM is approved by the supervisor and then automatically sent to the laboratory Project Manager by e-mail so that the client can be notified as appropriate. The QA department also receives NCMs by e-mail for tracking and trending purposes. The NCM process is described in more detail in SOP ED-GEN-003. The NCM shall be filed in the project file and addressed in the case narrative. Any unauthorized deviations from this procedure must also be documented as a nonconformance, with a cause and corrective action described.

2.0 Summary of Method

2.1 This method is used for the analysis of aqueous and solid matrices for semi-volatile base, neutral and acid organic compounds that are extracted from the sample matrix with an organic solvent.

2.2 An aliquot of sample containing surrogate spiking compounds is extracted with an organic solvent. The extract is concentrated on a steam bath to a suitable volume. Internal standards are added to the extract.

2.3 Sample extraction techniques are specified for each matrix in the following Eurofins Edison SOPs:

- ED-ORP-002 (*Extraction of Semivolatile Organic Compounds in Water by Separatory Funnel, SW846 Method 3510C*);
- ED-ORP-043 (*SW846 Method 3580A - Waste Dilution Prep for Analysis of BNAs by SW846 Method 8270);*
- ED-ORP-0044 (*Microwave Extraction for Solids, SW846 Method 3546*);

2.4 A small aliquot of the extract is injected into a gas chromatograph (GC) equipped with a capillary column. The GC is temperature programmed to separate the compounds which were recovered during the extraction step by boiling point. The effluent of the gas chromatograph is interfaced to a mass spectrometer (MS) which is used to detect the compounds eluting from the GC. The detected compounds are fragmented with an electron beam to produce a mass spectrum which is characteristic of the compound introduced into the MS. Identification of target analytes is accomplished by comparing their mass spectra with the electron ionization spectra of authentic standards. Quantitation is accomplished by comparing the response of a major ion (quantitation ion) relative to an internal standard established through a five-point calibration (six points for second order regression). Specific calibration and quality control steps are included in the method that must be performed and must meet the specifications of SW846 Method 8270E as applicable.

2.5 The standard preparation procedure for aqueous samples involves use of a Reduced Volume Extraction (250 ml) (RVE) followed by analysis using a Large Volume Injection (LVI). Optionally, a full volume (1000 ml nominal) may be employed. The details of the extractions are outlined in the applicable prep SOPs while the analytical details for 8270E is presented in this SOP.

2.6 These methods are also applicable to the analysis of samples by Selected Ion Monitoring (SIM) for the purpose of obtaining lower reporting limits for the following compounds:

Table 2 –
SIM Analytes

SIM Analytes	CAS #
1,4-Dioxane	123-91-1
4,6-Dinitro-2-methylphenol	534-52-1
Acenaphthene	83-32-9

**Table 2 –
SIM Analytes**

SIM Analytes	CAS #
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo[a]anthracene	56-55-3
Benzo[a]pyrene	50-32-8
Benzo[b]fluoranthene	205-99-2
Benzo[g,h,i]perylene	191-24-2
Benzo[k]fluoranthene	207-08-9
Bis(2-chloroethyl)ether	111-44-4
Chrysene	218-01-9
Dibenz(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Hexachlorobenzene	118-74-1
Indeno[1,2,3-cd]pyrene	193-39-5
Naphthalene	91-20-3
N-Nitrosodimethylamine	62-75-9
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Pyrene	129-00-0

2.7 An isotope dilution selected ion monitoring (SIM) technique for the analysis of 1,4-dioxane in water at a reporting level of 0.2 ug/l is also described in this SOP. Using this technique 1,4-dioxane-d8 is added prior to sample extraction and is used as an internal standard to calculate the concentration of 1,4-dioxane present. Additionally, 1,4-dichorobenzene-d4 is added to the extract prior to analysis to monitor the recovery of 1,4-dioxane-d8.

3.0 Definitions

For a complete list of definitions refer to Appendix 2 in the most current revision of the Quality Assurance Manual (ED-QA-LQM).

4.0 Interferences

4.1 GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Analysts must take steps to determine the source of the interference and take corrective action to eliminate the problem.

4.1.1 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe is automatically rinsed with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of a solvent blank to check for cross-contamination. Alternately, verify that the sample analyzed after the high concentration sample does not show any carryover through inspection of chromatogram and target results.

4.1.2 Contaminants from the extraction process detected in the method blank should be evaluated to determine the impact on the analysis. Interferences from any target analyte must not be present in the method blank above the reporting limit for that compound. If these types of interferences occur, corrective action is required. The source should be identified and corrective action initiated to eliminate the interference from the extraction process. Affected samples must be re-extracted and re-analyzed.

4.1.3 The analyst must take precautions to make sure that contaminants do not enter the analytical system. These precautions include systematic procedures designed to eliminate interferences.

4.2 Some compounds analyzed by this method are unstable or sensitive to extraction and/or instrument conditions:

- Benzidine is easily oxidized during extraction. Neutral extraction may enhance the recovery of this compound.
- Hexachlorocyclopentadiene breaks down photochemically and can decompose from high temperatures, particularly in the injection port of the GC. This compound can also react with acetone in solution.
- 1,2-Diphenylhydrazine is unstable even at room temperature and readily converts to azobenzene.
- Phenols are sensitive to active sites and can give a low response or exhibit poor chromatography by tailing. Therefore, it is important the GC is maintained in the best possible condition. See Section 10.1 for proper daily maintenance.
- N-Nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be distinguished from diphenylamine.
- 3-Methylphenol cannot be separated from 4-methylphenol by the conditions specified in this method. They are reported as 3 and 4-methylphenol.
- Pyridine may perform poorly at the GC injection port temperatures listed in this SOP. Lowering the injection port temperature may reduce the amount of degradation.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1. Specific Safety Concerns or Requirements

The gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.2. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Toluene	Flammable Poison Irritant	200 ppm-TWA 300 ppm-Ceiling	Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Causes severe eye and skin irritation with redness and pain. May be absorbed through the skin.
Dimethyl-dichloro-silane	Flammable	none	Can be corrosive to the respiratory tract causing severe irritation and tissue damage. Harmful if absorbed through the skin. May cause severe irritation and systemic damage. Severely irritating to the skin and eyes. Harmful if swallowed. Can cause abdominal discomfort, nausea, vomiting, diarrhea, and irritation to the mouth, throat and stomach.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Gas chromatograph/mass spectrometer system

6.1.1 Gas chromatograph: An Agilent/HP 6890/7890/900 Intuvo (or equivalent) houses the capillary column. The GC provides a splitless injection port and allows the column to be directly coupled to the mass spectrometer. The oven is temperature programmable to meet the requirements of the method. An HP/Agilent 7673/7683/7963 autosampler (or equivalent) with a 10 ul syringe provides automatic injection of sample extracts while the instrument is unattended.

6.1.2 Analytical Column: 30m x 0.25mm ID, 0.25 um film thickness, Restek Rxi-5Sil MS, Catalog #13623

6.1.3 Mass spectrometer: Agilent (HP) 5972, 5973, 5975 or 5977A Mass Selective Detector (MSD) Capable of scanning from 35 to 500 amu every 1 sec or less, using 70 volts electron energy in the electron ionization mode. The mass spectrometer must be capable of producing a mass spectrum for 50 ng of decafluorotriphenylphosphine (DFTPP) which meets the criteria in Section 9.2.1 when 2 ul of the 25 ug/ml GC/MS tuning standard is injected through the GC.

6.1.4 GC/MS interface: Any GC-to-MS interface may be used that gives acceptable calibration points at 50 ng per injection for each compound of interest and achieves acceptable tuning performance criteria.

6.1.5 Data system: The data system is interfaced to the mass spectrometer and accommodates continuous acquisition and storage of GC/MS data throughout the duration of the chromatographic program. The data system consists of a Hewlett-Packard Chemstation equipped with Mustang software used for instrument control and data acquisition. This, in turn, is interfaced to Eurofins's Chrom software for data processing. Data from sample extract analysis can be accessed in real-time, while sample data reports and library searches can be performed on data files from previously run samples. The software is also capable of searching any GC/MS data file for ions of a specific mass whose abundances can be plotted versus time or scan number which allows integration of abundances for any extracted ion between specified times or scan-number limits. Library searches utilize a NIST 02.1 Mass Spectral Library.

6.2 Bottles, glass with polytetrafluoroethylene (PTFE)-lined screw caps or crimp tops.

6.3 Injection port liners, splitless

6.4 Injection port septa

6.5 Injection port graphite seals

6.6 Pre-silanized glass wool (Supelco 2-0411 or equivalent)

6.7 Syringes, Assorted sizes 10ul - 1000ul; gas-tight

6.8 Bottles, 10 and 5ml amber screw cap with Teflon liner

6.9 Vials, 2ml amber screw cap with Teflon liner

6.10 Wheaton microvials 100ul (or equivalent)

6.11 Volumetric Flasks, Class A with ground glass stoppers (2ml - 100ml)

6.12 Analytical balance, ASP Model SP-180 (or equivalent), capable of accurately weighing to 0.0001 gr.

7.0 Reagents and Standards

The following items are recommended for performing this procedure. Equivalent items should only be used when they result in an improvement in quality, efficiency, productivity, or cost. An item can be considered equivalent if with its use, the analytical and QA/QC requirements in this SOP can be met. Please refer to the MSDS prior to the use of any reagent or standard.

The preparation of standards, surrogates and spiking solutions is documented in the TALS Reagent Module. Formulary reports can be generated upon request.

7.1. Reagents:

7.1.1. Methylene Chloride: J.T.Baker Resi-Analyzed, used for Organic Residue Analysis (P/N 9266-V8 or equivalent).

7.1.2. Methanol: J.T.Baker Purge and Trap Grade (P/N 9077-02 or equivalent).

7.1.3. Sylon-CT: Supelco (P/N 33065-U or equivalent). Sylon-CT is a highly reactive silanizing reagent consisting of 95% Toluene and 5% Dimethyldichlorosilane (DMDCS).

7.1.4. Each lot of solvent is screened for contaminants before being used for analysis as detailed in Eurofins Corporate Quality SOP No. CA-Q-S-001 (*Solvent & Acid Lot Testing & Approval*) and Eurofins Edison SOP No. ED-GEN-023 (*Bulk Solvent Testing and Approval*).

7.2. Standards:

7.2.1. **Calibration Standards (Full Scan Analysis)**: Stock analytical standard solutions are purchased mainly from Restek Corporation. Other standards are prepared in the laboratory as needed using neat compounds or prepared solutions purchased from Agilent, SPEX CertiPrep, Chem Service, Accustandard, Supelco or other suppliers. Standards prep instructions are detailed for the following full scan analyte list options:

- Full Volume Aqueous Prep; and,
- Reduced Volume Aqueous Prep and Soils

Secondary dilutions are either made from purchased stock solutions as listed below or from prepared solutions as listed in the following table:

NOTE: Second sources (from certified separate lots) are used for ICV standards.

Table 3 –
Full Scan Stock Standards

Target Analyte Standard Name	Conc. (PPM)	Vendor	Catalog #
1,2,3,4-TCDD	50	SPEX	SVO-TANJ-12
Agilent Mix (contains compounds listed in Table 4 below)	2000 *	Agilent	Cus 0456
8270 List 1/ Std #1 Megamix	Varied	Restek	571995
8270 List 1/ Std#9	2000	Restek	569730
8270 List 1/ Std#11	2000	Restek	569732
8270 Surrogate Standard	5000*	Restek	567685
8270 Internal Standard	2000	Restek	567684
8270 List 1/ Std#10	2000	Restek	569731
Bisphenol-A	1000	Agilent	Cus-0457

*Agilent Mix, 8270 list1/std#9 and 8270 Surrogate standard are diluted to 100ppm prior to the preparation of the 1.0ppm and 0.5ppm standards.

Table 4
Agilent Mix
Catalog No. Cus-0456

Analyte	Concentration (PPM)
Pentachloronitrobenzene	2000
2 -tert-butyl-4-Methylphenol	2000
2,6-Di-tert-butyl-4-Methylphenol	2000
Coumarin	2000
Phenyl ether	2000
N,N’-Dimethylaniline	2000
N-Methylaniline	2000
Carbamazepine	2000
Benzonitrile	2000
1,3-Dimethylnaphthalene	2000

7.2.1.1. Individual calibration standards for full scan analysis are prepared in one of several ways depending upon the technique (full volume aqueous prep, soils prep, reduced volume prep with LVI) as well as the target analyte list. The following tables detail the preparation of calibration standard solutions for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 5
Full Volume Aqueous Prep and Soils
Working Standards Preparation

Solution Name	120 PPM	80 PPM	50 PPM	20 PPM	10 PPM	5 PPM	2 PPM	1 PPM	0.5 PPM
8270 List 1/ Std #1 Megamix	3000 ul	2000 ul	2500 ul	500ul	250ul	250ul	100ul	50ul	25ul
8270 List 1/ Std #9	1500 ul	1000 ul	1250 ul	250ul	125ul	125ul	50ul	500ul*	250ul *
8270 List 1/ Std #10	1500 ul	1000 ul	1250 ul	250ul	125ul	125ul	-	-	-
Agilent custom Mix	1500 ul	1000 ul	1250 ul	250ul	125ul	125ul	50ul	500ul*	250ul *
1,2,3,4-TCDD	-	-	500ul	-	-	-	-	-	-
8270 Surrogate Standard	600ul	400ul	500ul	100ul	50ul	50ul	20ul	500ul*	250ul *
8270 Internal Standard	500ul	500ul	1000 ul	500ul	500ul	1000 ul	1000 ul	1000 ul	1000 ul
Bisphenol-A	3000 ul	2000 ul	2500 ul	500ul	250ul	250ul	100ul	-	-
8270 List 1/ Std #11	400ul	300ul	500ul	200ul	125ul	125ul	50ul	25ul	-
Final Volume (ml)	**25**	**25**	**50**	**25**	**25**	**50**	**50**	**50**	**50**

Note: The 1.0ppm and 0.5pmm standards (above) are prepared using the 100ug/ml standard for Agilent custom Mix, 8270 List1/std#9 and 8270 Surrogate Standard.

Table 6
Reduced Volume Extraction/LVI
Working Standards Preparation

Solution Name	24 PPM	16 PPM	10 PPM	4 PPM	2 PPM	1 PPM	0.4 PPM	0.2 PPM	0.1 PPM
120 ppm (see Table 5)	2.0mL								
80 ppm (see Table 5)		2.0 mL							
50 ppm (see Table 5)			2.0 mL						
20 ppm (see Table 5)				2.0 mL					

Table 6 Reduced Volume Extraction/LVI Working Standards Preparation									
Solution Name	**24 PPM**	**16 PPM**	**10 PPM**	**4 PPM**	**2 PPM**	**1 PPM**	**0.4 PPM**	**0.2 PPM**	**0.1 PPM**
10 ppm (see Table 5)					2.0 mL				
5.0 ppm (see Table 5)						2.0 mL			
2.0 ppm (see Table 5)							2.0mL		
1.0 ppm (see Table 5)								2.0 mL	
0.5 ppm (see Table 5)									2.0mL
Final Volume (ml)	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**

7.2.1.2. **Initial Calibration Verification (full scan)**: Second source ICVs for full scan analysis are prepared in one of several ways depending upon the technique (full volume aqueous prep, soils prep, reduced volume prep with LVI) as well as the target analyte list. The following tables detail the preparation of ICVs for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 7 8270/625 ICV Working Standards Preparation	
Solution Name	**25 PPM**
8270 List 1/ Std #1 Megamix (2nd Lot)	250ul
8270 List 1/ Std #9 (2nd Lot)	125ul
8270 List 1/ Std #10 (2nd Lot)	125ul
Agilent custom Mix (2nd Lot)	125ul
8270 Internal Standard	200ul
8270 List 1/ Std#11	125ul
Bisphenol-A (2nd Lot)	250ul
Final Volume (ml)	**10**

7.2.1.3. **Surrogate Standards (Full Scan Analysis):** A 5000ppm Surrogate Standard is purchased from Restek for use in spiking blanks, samples and associated QC prior to extraction (reference the applicable sample prep SOPs for spiking instructions).

Table 8 Full Scan Surrogate Standards Solution Restek Catalog No. 567685	
Surrogate Standard Compounds	**Concentration (PPM)**
Nitrobenzene-d5	5000
p-Terphenyl-d14	5000
2,4,6-Tribromophenol	5000
Phenol-d5	5000
2-Fluorobiphenyl	5000
2-Fluorophenol	5000

7.2.1.4. **Internal Standards** (**Full Scan Analysis**): The Internal Standards Solution at 2000ppm is purchased from Restek (Catalog # 567684). The Internal Standard solution is stored in 10ml amber screw cap bottles with Teflon liners in the dark at 4°C. The Internal standard solution is used in preparing all analytical standards. Inject 20ul of this solution (2000ppm) per ml of sample extract prior to analysis resulting in a concentration of 40ppm (ug/ml) in the extract.

Table 9 Full Scan Internal Standards Solution Restek Catalog No. 567684	
Internal Standard Compounds	**Concentration (PPM)**
1,4-Dichlorobenzene-d4	2000
Phenanthrene-d10	2000
Naphthalene-d8	2000
Chrysene-d12	2000
Acenaphthene-d10	2000
Perylene-d12	2000

7.2.2. **Calibration Standards (SIM analysis)**: The Edison lab currently analyzes only a select list of compounds by 8270E SIM (see Sections 1.0 and 2.0). Stock analytical SIM standard solutions are purchased mainly from Agilent. Working standards are prepared from these solutions as listed in the tables in Section 7.2.2.1:

Table 10 Stock SIM Standards			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
Pentachlorophenol	1000ppm	AGILENT	PH-180-1
n-Nitrosodimethylamine	100ppm	AGILENT	NS-100-1
Hexachlorobenzene	100ppm*	AGILENT	CH-151-1
PAH Mix	100ppm	AGILENT	PAH-605-1
Bis(2-chloroethyl)ether	100ppm*	AGILENT	BEC-110-1
4,6-Dinitro-2-methylphenol	1000ppm**	AGILENT	PH-150
1,4-Dioxane	1000ppm**	AGILENT	NV-152-1

*Hexachlorobenzene and Bis(2-chloroethyl)ether are diluted to 10ppm prior to SIM Standards prep

** 4,6-Dinitro-2-methylphenol and 1,4-Dioxane is diluted (10x) to 100ppm prior to SIM Standards prep

NOTE: Second sources (from separate lots are used for ICV standards).

7.2.2.1 Individual calibration standards for SIM analysis are prepared in one of two ways depending upon the technique (full volume aqueous prep or reduced volume prep with LVI) as well as the target analyte list. The following tables detail the preparation of calibration standard solutions for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 11
Full Volume Aqueous Prep – SIM
Working Standards Preparation

	0.025 PPM	**0.05 PPM**	**0.1 PPM**	**0.5 PPM**	**1.0 PPM**	**5.0 PPM**
Pentachlorophenol	2.5uL	2.5uL	12.5uL	10uL	20uL	50uL
n-Nitrosodimethylamine	25uL	25uL	125uL	100uL	200uL	500uL
PAH mix	6.25uL	5uL	25uL	50uL	100uL	200uL
Hexachlorobenzene	25uL	25uL	250uL	1000uL	2000uL	500uL*
Bis(2-chloroethyl)ether	25uL	25uL	250uL	1000uL	2000uL	500uL*
4,6-dinitro-2-methylphenol	50ul	50ul	250ul	200ul	400ul	1000ul
1,4-Dioxane	25ul	50ul	250ul	200ul	400ul	1000ul
ISTD	500uL	200uL	500uL	200uL	200uL	200uL
Final Volume (ml)	**25**	**10**	**25**	**10**	**10**	**10**

*For Hexachlorobenzene and Bis(2-chloroethyl)ether the 5.0 ppm level is prepared using the 100ppm standard.

Table 12
Reduced Volume Extraction/LVI – SIM
Working Standards Preparation

	0.005 PPM	**0.01 PPM**	**0.02 PPM**	**0.10 PPM**	**0.20 PPM**	**1.0 PPM**
0.025 PPM Std (see Table 11)	1.0 mL					
0.05 PPM Std (see Table 11)		1.0 mL				
0.1 PPM Std (see Table 11)			1.0 mL			
0.5 PPM Std (see Table 11)				1.0 mL		
1.0 PPM Std (see Table 11)					1.0 mL	
5.0 PPM Std (see Table 11)						1.0 mL
Final Volume (ml)	**5**	**5**	**5**	**5**	**5**	**5**

7.2.2.2 Initial Calibration Verification (SIM): A 0.1 ppm separate lot SIM ICV is prepared as detailed in Table 13 using the stock standards detailed in Section 7.2.2 (above)

Table 13 0.1ppm SIM ICV preparation	
Pentachlorophenol	25uL
n-Nitrosodimethylamine	25uL
PAH mix	5uL
Hexachlorobenzene	5uL
1,4-Dioxane	5ul
4,6-Dinitro-2-methylphenol	100ul
ISTD	**100uL**
Final Volume	**5 ml**

7.2.2.3 Internal Standard solution (SIM): A 50 ppm Internal Standard solution for SIM analysis is prepared by adding 125ul of the 2000ppm stock ISTD (see Section 7.2.1.4) and bringing to volume with Methylene Chloride in a 5ml volumetric flask.

7.2.2.3.1 For SIM analysis inject 20ul of this solution (50ppm) per ml of sample extract prior to analysis resulting in a concentration of 1ppm (ug/ml) in the extract.

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7.2.3. Calibration Standards (Isotope Dilution SIM – 1,4-Dioxane): The Edison lab currently analyzes only for 1,4-dioxane by 8270E isotope dilution SIM (see Sections 1.0 and 2.0). Stock analytical isotope dilution SIM standard solutions are purchased mainly from Accustandard and Restek. Working standards are prepared from these solutions as listed in the tables below.

Table 14 - Stock 1,4-Dioxane Isotope Dilution SIM Standards			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dioxane	1000ppm*	Accustandard	APP-9-096

* 1,4-Dioxane is diluted (10x) to 100ppm prior to SIM Standards prep

Table 15 - Stock Labeled 1,4-Dioxane SIM Surrogate/Internal Standard (added at prep)			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dioxane-d8	2000ppm	Restek	30614

Table 16 -
Stock 1,4-Dioxane Isotope Dilution SIM Internal Standard (added to extract)

Standard Name	Concentration	Vendor	Catalog #
1,4-Dichlorobenzene-d4	2000ppm	Accustandard	AZ-014J-3

7.2.3.1 Individual calibration standards for 1,4-dioxane isotope dilution SIM analysis are prepared at the concentrations detailed in the following tables. Prepare by combining the appropriate volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 17
Reduced Volume Extraction/LVI – 1,4-Dioxane Isotope Dilution SIM
ICAL Standard Concentrations (ug/ml)

	Lev 1	Lev 2	Lev 3	Lev 4	Lev 5	Lev 6	Lev 7	Lev 8	ICV*
1,4-Dioxane	0.02	0.04	0.1	0.2	0.5	1	2	10	0.2
1,4-Dioxane-d8	4	4	4	4	4	4	4	4	4
1,4-Dichlorobenzene-d4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

***:** The ICV is prepared from the second source stock in Table 13.

7.2.4. **GC/MS Instrument Performance Check (DFTPP):** The DFTPP standard is prepared by is prepared at 25 ppm by adding 2.5ml of EPA 8270 GC/MS Tuning Solution II (Restek Catalog # 31615) to a 100ml volumetric flask and bringing to volume with Methylene Chloride.

7.2.5. Information on prepared standard solutions must be recorded in the TALS Reagent Module. Information such as standard supplier, lot number, original concentration, a description of how the standard was made, are required along with the laboratory lot number, analyst's initials, date prepared, expiration date and verification signature. Standards must be remade every 6 months, or sooner, if the standards expire or begin to show signs of unacceptable degradation. Class "A" volumetric must be used at all times and syringes, preferably gas-tight syringes when available, should be checked for accuracy using an analytical balance. Class "A" pipettes should also be used if volumes permit.

7.2.6. Please refer to Eurofins Edison SOP No. ED-GEN-008, Standard Operating Procedure for Preparation, Purity and storage of Reagents and Standards.

- Shelf Life of Standard: 1 year after preparation or stock standard manufacture expiration, whichever comes first;
- Storage Requirements: Stock standards are stored at 4°C and Working Standards stored at -10°C to -20°C.

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 Samples from chlorinated water sources must be treated with sodium thiosulfate (0.008% solution) at the time of collection to remove chlorine. NOTE: containers pre-preserved with sodium thiosulfate must be requested in bottle orders for samples from chlorinated water sources.

8.2 All samples must be stored at 4°C (± 2°C) upon receipt.

8.3 Sample Extract Storage. Samples extracts must be protected from light and refrigerated at 4°C (± 2°C) from time of extraction until analysis.

8.4 Sample Extract Holding Time. All sample extracts must be analyzed within 40 days of extraction.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time	Reference
Waters	Amber glass, 1L	1000 ml or 250 ml (1)	Cool 4 ± 2°C	7 days to extraction; Analyze within 40 days of extraction	EPA Method SW846 8270E
Solids	Wide mouth glass, 8 or 16 oz.	50g	Cool 4 ± 2°C	14 days to extraction; Analyze within 40 days of extraction	EPA Method SW846 8270E

(1) : Reduced volume extraction (RVE) LVI option

9.0 Quality Control

9.1. **Sample QC** - The following quality control samples are prepared with each batch of samples.

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	< Rpt. Limit
Laboratory Control Sample (LCS)[1]	1 in 20 or fewer samples	Statistical Limits [4]
Matrix Spike (MS)[2]	1 in 20 or fewer samples	Statistical Limits [4]
MS Duplicate (MSD)[2]	1 in 20 or fewer samples	Statistical Limits [4]
Surrogates	every sample[3]	Statistical Limits [4]
Internal Standards	Every sample	Response within -50% to +100% of CCV

[1] LCS Duplicate (LCD) is performed only when insufficient sample is available for the MS/MSD or when requested by the client/project/contract.

[2] The sample selection for MS/MSD are randomly selected, unless specifically requested by a client….predetermined by the extraction lab.
[3] Analytical and QC samples (MB, LCS, MS/MSD, Method Blank)
[4] Statistical control limits are determined annually and are updated into TALS limit group..

9.1.1. **Method blanks** are extracted with every sample batch on each day that samples are extracted. To be considered acceptable, the method blank must contain less than the reporting limit of all target compounds except for phthalates, which can be present at up to 5x the MDL. For method 8270E the method blank is generally acceptable if target analyte concentrations are less than the one half the reporting limit.

If method blanks are unacceptably contaminated with target compounds that are also present in field samples, all affected samples must be re-extracted and re-analyzed. Corrective action must be taken to identify and eliminate the contamination source. Demonstrate that acceptable blanks can be obtained before continuing with sample extraction and analysis. Method blanks must be analyzed on each instrument on which the associated samples are analyzed.

9.1.1.1. Surrogate recoveries for the method blank are compared to laboratory generated limits. If two or more surrogates for any one fraction (base-neutral or acid) are outside of recovery limits or if any one surrogate recovers at <10%, the sample must be re-extracted and re-analyzed to confirm matrix interference.. If any surrogate is still outside limits, all samples and QC samples associated with that method blank must be re-extracted (volume permitting).

9.1.2. **Matrix Spike (MS)/Matrix Spike Duplicate (MSD):** A matrix spike/matrix spike duplicate (MS/MSD) pair is extracted and analyzed with every 20 environmental samples of a specific matrix (defined as a sample batch). Full compound list spiking is employed for MS/MSDs and LCSs. These spikes are prepared and extracted concurrent with sample preparation. MS and MSD recoveries are calculated and compared to lab generated acceptance criteria. See the current active TALS 8270 Method Limit Group for QC limits. The MS/MSD spiking solution should the same as used for the calibration standards.

9.1.2.1 A Laboratory Control Sample Duplicate (LCSD) is extracted and analyzed only when insufficient client sample is available for preparation of an MS/MSD pair. The LCS/LSCD is evaluated in the same manner as the MS/MSD (see Section 9.1.2)

9.1.2.2 An LCS/LCSD may be substituted for the MS/MSD if insufficient sample volume is available.

9.1.3. **Laboratory Control Sample (LCS)/Laboratory Control Sample Duplicate (LCSD):** A Laboratory Control Sample (LCS) (aka blank spike) must be extracted and analyzed with each batch of 20 environmental samples. The LCS data is used to assess method performance if the MS/MSD recoveries fall outside of the lab generated limits (See the current active TALS 8270 Method Limit Group for QC limits). If the LCS recovery is within the current lab generated limits, the MS/MSD recoveries are attributed to matrix interference.

9.1.3.1 A Laboratory Control Sample Duplicate (LCSD) is extracted and analyzed only when insufficient client sample is available for preparation of an MS/MSD pair. The LCS/LSCD is evaluated in the same manner as the MS/MSD (see Section 9.1.2)

9.1.3.2 Spike recovery limits are lab generated and are updated annually. Certain state regulatory programs have defined recovery limits which, where applicable, are used for spike recovery evaluations. The TALS Method Limit Groups detail these regulatory program criteria.

9.1.4. **Surrogate Standards:** All full scan samples, blanks and QC samples are spiked with a six (6) component surrogate standard mix (see Section 7.2.1.3). The percent recovery of the surrogate standards is calculated and compared to lab generated limits (See the current active TALS 8270 Method Limit Group for QC limits).

If any two or more surrogates for any one fraction (base-neutral or acid) are outside of recovery limits or if any one surrogate recovers at <10%, the sample must be re-extracted and re-analyzed to confirm matrix interference. If a surrogate is diluted to a concentration below that of the lowest calibration standard, no corrective action is necessary.

9.1.4.1 Surrogate recovery limits are lab generated and are updated annually. Certain state regulatory programs have defined recovery limits which, where applicable, are used for spike recovery evaluations. The TALS Method Limit Groups detail these regulatory program criteria.

9.1.5. **Internal Standards:** The response (area count) of each internal standard in the sample must be within -50 +100% of its corresponding internal standard in the CCV or, the ICAL midpoint for samples analyzed under the initial calibration range. Failure to meet these criteria is indicative of sample matrix effects. All samples failing these criteria must be reanalyzed to confirm matrix effects.

9.2. Instrument QC

9.2.1 **GC/MS Instrument Performance Check (DFTPP)**: (**Note**: the DFTPP performance check applies only to full scan analyses and is not evaluated for SIM analysis). The GC/MS system is tuned using Perfluortributylamine

(PFTBA) such that an injection of 50ng of Decafluorotriphenylphosphine (DFTPP) meet the abundance criteria listed in the table below. Prior to the analysis of any calibration standards or samples, the GC/MS system must meet all DFTPP key ion abundance criteria. This analysis will verify proper tuning of the system for a period of 12 hours post-injection. After 12 hours, the instrument performance must again be verified prior to the analysis of standards, QC or samples. Daily tune verification is not required for 8270E CCV.

DFTPP Key Ions and Abundance Criteria	
Mass	**Ion Abundance Criteria**
51	30-60% of mass 198
68	<2% of mass 69
69	reference only
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base Peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

9.2.1.1. Evaluate DFTPP using three scan averaging and background subtraction techniques. Select the scan at the peak apex, add +1 scan from the apex and -1 scans from the apex.

9.2.1.2. The mass spectrum of DFTPP may be background subtracted to eliminate column bleed or instrument background ions. Background subtract DFTPP by selecting a scan for subtraction ≤20 scans <u>before</u> the apex scan of DFTPP.

9.2.1.3. Check column performance using pentachlorophenol and the benzidine peaks (these compounds are included in the DFTPP solution). Benzidine & Pentachlorophenol should respond normally without significant peak tailing (Tailing Factor should be <2 measured at 10% peak height). If responses are poor and excessive peak tailing is present, corrective action for the GC/MS instrument may be required. Corrective actions may include:

9.2.1.3.1 Retune the GC/MS;
9.2.1.3.2 Clip the injector end of the GC column;
9.2.1.3.3 Replace the septum and injection port liner;
9.2.1.3.4 Change the injection port seal;

9.2.1.3.5 Replace the GC column;
9.2.1.3.6 Clean the injection port with MeCl2
9.2.1.3.7 Clean the MS ion source;
9.2.1.3.8 Place a service call.

9.2.1.4. The breakdown of 4, 4-DDT into 4,4-DDD and 4,4'DDE may also be used to assess GC column performance and injection port inertness. If so evaluated the breakdown must be <20%.

9.2.1.5. DFTPP parameter settings are stored in a tune file, which will be used in all subsequent analysis of standards and sample extracts.

9.2.2 Initial Calibration Range and Initial Calibration Verification

9.2.2.1. **Initial Calibration:** The initial calibration range consists of a minimum of five concentration levels of analytical standards (six for second order regression) prepared as described in Section 7.2. and analyzed once the DFTPP instrument performance check has met the criteria in Section 9.2.1. .

9.2.2.2. **Initial Calibration Verification (ICV):** An Initial Calibration Verification (ICV) standard is analyzed immediately after the Initial Calibration Range and before any samples are analyzed. The ICV is prepared as detailed in Section 7.2. The ICV must be from a source (or lot) separate from the standards used in the Initial Calibration Range.

9.2.3 **Continuing Calibration Verification (CCV) and Low Level Continuing Calibration Verification (LLCCV):** A mid-point Continuing Calibration Verification (CCV) must be analyzed every 12 hours after the DFTPP instrument performance check (when applicable).. The CCV is prepared as detailed in Section 7.2. (typically, 50 ug/ml for full volume aqueous and soils, 10 ug/ml for LV, 0.02 ug/ml for LVI SIM) and 0.2 for isotope dilution SIM). Additionally a Low Level Continuing Calibration Verification (LLCCV) is analyzed after the CCV for full scan analysis. The LLCCV is the same as the lowest calibration level analyzed with the initial calibration range (See Section 7.2).

9.2.4 Calibration Acceptance Summary

9.2.4.1. **Retention Time Windows:** Retention time windows must be established to compensate for minor shifts in absolute retention times as a result of sample loading and normal chromatographic variability. Obtain the retention time for all compounds from the analysis of the midpoint standard for the calibration curve. Establish the center of the retention time window by using the absolute retention time for each analyte, internal standard and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration. For qualitative identification to be acceptable the retention time of the relative retention time (automatically calculated in Chrom) must be within 0.8 - 1.2 RRT units of its assigned internal standard. The relative retention times of each compound in the five calibration standards must agree within .06 relative retention time units.

9.2.4.2. **Initial Calibration Range:** Internal standard calibration is employed for this method. After the initial calibration range has been analyzed the relative response factor (RRF) for each target/surrogate compound at each concentration level is determined using the following equation.

$$RRF = \frac{A_x}{A_{is}} \times \frac{C_{is}}{C_x}$$

Where:

A_x = Area characteristic ion (see Table 21) for the compound
Ais = Area characteristic ion (see Table 21) of associated internal standard
Cis = Concentration of internal standard
Cx = Concentration of compound in standard

9.2.4.2.1. Determine the mean RRF for each compound. Minimum response factors must be met for each of the compounds listed in Table 18 (below). Any compound that fails the minimum response factor must be reported as estimated for detects and must have a demonstration of sensitivity in the analytical batch to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only but the standard qualitative identification criteria in the method must be met.

Table 18:
Minimum Response Factors

Compound	Minimum Response Factor
Benzaldehyde	0.010
Phenol	0.800
Bis(2-chloroethyl) ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.700
2,2-Oxybis-(1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600

Table 18: Minimum Response Factors	
Compound	**Minimum Response Factor**
N-Nitroso-di-n-propylamine	0.500
Hexachloroethane	0.300
Nitrobenzene	0.200
Isophorone	0.400
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.200
Bis(2-chloroethoxy)methane	0.300
2,4-Dichlorophenol	0.200
Naphthalene	0.700
4-Chloroaniline	0.010
Hexachlorobutadiene	0.010
Caprolactam	0.010
4-chloro-3-methylphenol	0.200
2-Methylnaphthalene	0.400
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200
1,1’-Biphenyl	0.010
2-Chloronaphthalene	0.800
2-Nitroaniline	0.010
Dimethyl phthalene	0.010
2,6-Dinitrotoluene	0.200
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.900
2,4-Dinitrophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4-Dinitrotoluene	0.200
Diethyl phthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-chlorophenyl-phenyl ether	0.400
Fluorene	0.900
4-Nitroanailine	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenyl ether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.700
Anthracene	0.700
Carbazole	0.010
Di-n-butyl phthalene	0.010

**Table 18:
Minimum Response Factors**

Compound	Minimum Response Factor
Fluoranthene	0.600
Pyrene	0.600
Butyl benzyl phthalate	0.010
3,3'-Dichlorobenzidine	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Bis-(2-ethylhexyl)phthalate	0.010
Di-n-octyl phthalate	0.010
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010
Pentachloronitrobenzene	0.050

9.2.4.2.2. Calculate the Standard Deviation (SD) and Percent Relative Standard Deviation (% RSD) of the response factors for each compound:

$$\%\ RSD = \frac{\text{Standard Deviation of RRFs}}{\text{Mean RRF}}$$

9.2.4.2.3. The % RSD of the RRF's must be ≤20% for each target analyte listed in Table 18. The % RSD of each target analytes must be ≤20% in order for the calibration range to be acceptable. Additionally for 8270E, the calculated concentration or amount of each analyte of interest in the CCV standard should fall within ±20%. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit or do not meet the minimum correlation coefficient (0.99) or Relative Standard Error (≤20%) for alternate curve fits (see below) then appropriate corrective maintenance action must be performed. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit **AND** do not meet the minimum correlation coefficient (0.99)) or Relative Standard Error (≤20%) then recalibration is necessary.

9.2.4.2.4. If the above listed criteria is met, the system can be assumed to be linear and sample analysis may begin and the average RF from the initial calibration range is used to quantitate all samples.

9.2.4.2.4.1 Certain state regulatory programs have defined calibration acceptance limits which, where applicable, are used for calibration evaluations. The TALS ICAL Limit Groups detail these regulatory program criteria.

9.2.4.2.5. An alternative calibration technique may be employed for those any compounds exceeding the 20% RSD criteria:

9.2.4.2.5.4 Calculate the first order linear regression for any compound which did not meet the 20% criteria. First order linear regression calibration may be employed if alternative average response calibration procedures were not applicable. The r value (Correlation Coefficient) of the equation must be ≥0.99 or the Relative Standard Error (RSE) (≤20%) for the calibration to be employed.

9.2.4.2.5.2 Second order regression calibration can be used for any compound that has an established history as a non-linear performer.

9.2.4.2.5.3 If second order regression calibration is used a minimum of six (6) calibration levels must be analyzed.

9.2.4.2.5.4 If second order regression calibration is used, the r^2 (Correlation Coefficient) value must be $\geq$ 0.99 or the Relative Standard Error (RSE) (≤20%) for the calibration to be employed.

9.2.4.2.5.5 Any compound that fails to meet the 20% RSD or 0.99 correlation coefficient or RSE (≤20%) criteria must be flagged as estimated for detects (or must be noted in the narrative). If there are non-detects the compounds may be reported if there is adequate sensitivity to detect at the quantitation limit. To demonstrate adequate sensitivity analyze the low level point of the initial calibration in each analytical batch (LLCCV) The criteria for demonstrating adequate sensitivity is detection in the LLCCV using the standard qualitative identification criteria.

9.2.4.2.5.6. When calculating the calibration curve using the linear calibration model a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration back into the curve. The recalculated concentration of the low calibration point should be within ±50% of the standard's concentration. This evaluation can be checked using the Initial Calibration %Drift Report in Chrom. Any detects for analytes calibrated using the linear model and failing this readback criterion must be flagged as estimated or detailed in the narrative.

9.2.4.3. **Calibration Point Read-back Criteria**: Whichever calibration model above is selected, it should be subjected to an additional check to establish the representativeness of the data that were used to produce it. This check is the refitting of each calibration point response back to the calibration model, or the comparison of the calculated amount of the standard against the expected amount.

- CHROM software provides an Initial Calibration %Drift report which shows the % Error for each calibration point. This report must be reviewed in addition to the %RSD / Linear Response Factor.

- The absolute value of the % Error for each calibration point should be < 30%. For the lowest calibration point, the % Error may be <50%.

- See Section 11.8 for the Calculation of Percent (%) Error.

9.2.4.4. **Initial Calibration Verification (ICV):**.Once the initial calibration has been analyzed and has met the above criteria, a second source Initial Calibration Verification (ICV) (as prepared in Section 7.2) must be analyzed and evaluated. The ICV must meet the criteria of 70-130% recovery for all compounds with the exception of the poor performing compounds listed in Attachment 1 which are allowed to be within 50-150% : An NCM must be initiated to denote any ICV non-conformances.

9.2.4.5. The ICV must meet the criteria of 70-130% recovery for all compounds however up to 10% of the compounds are allowed to exceed these criteria as long as their recoveries are within 65-135%. For the poor performers (see Attachment 1) the range is 50-150%. If the criterion is not met, a second ICV may be analyzed after corrective measures are taken. If a second ICV analysis fails to meet criteria proceed with corrective action and the analysis of a new initial calibration range. Flagging: If the ICV limits are outside of criteria (high) for an analyte and that analyte is undetected in the sample, no flagging or narration is required. If the ICV limits are outside of criteria (low) for an analyte and that analyte is undetected in a sample, narrate the non-conformance in an NCM. When that out of spec analyte is detected in a sample, describe the issue in the narrative, or flag as estimated.

9.2.4.6. Continuing Calibration Verification (CCV): A CCV consisting of a standard at or near the midpoint of the Initial Calibration Range is analyzed every 12 hours of instrument operation or at the beginning of an analytical sequence to verify the initial calibration. The calibration verification consists of a DFTPP instrument performance check (not required for 8270E), and analysis of a calibration verification standard. **Note:** Certain state regulatory programs have defined calibration acceptance limits which, where applicable, are used for calibration evaluations. The TALS ICAL Limit Groups detail these regulatory program criteria.

9.2.4.5.1 Tune Verification: Follow the procedure for verifying the instrument tune described in section 9.2.1 using a 50 ng injection of DFTPP. If the tune cannot be verified, analysis must be stopped, corrective action taken and a return to "control" demonstrated before continuing with the calibration verification process. For 8270E analysis only, tune verification is required just prior to ICAL.

9.2.4.5.2 Calibration Verification: Analyze the calibration verification standard immediately after a DFTPP that meets criteria. Daily analysis of the DFTPP is not required as part of the CCV for 8270E analysis. .When samples are analyzed after an ICAL the last ICAL standard may be used as the starting time reference for evaluation. Use the mid point calibration standard (approximately 50ug/l). NOTE: The calibration standard contains internal standards; Dichlorobenzene d_4, Naphthalene d_8, Acenaphthene d_{10}, Phenanthrene d_{10}, Chrysene d_{12}, and Perylene d_{12} at 40ug/l (0.1ug/L for SIM). The calibration check standard must also include all the target analytes from the original calibration.

9.2.4.5.3 The RFs must meet the criteria for the compounds in Table 18. Any compound that fails the minimum response factor must be reported as estimated for detects and must have a demonstration of sensitivity to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only but the standard qualitative identification criteria in the method must be met

9.2.4.5.4 The percent difference (when using average response factor) or percent drift (when using linear regression) of the compounds in Table 18 must be ≤20% for at least 80% of the total analyte list. If more than 20% of the compound list fail to 20% difference or drift criterion then appropriate corrective action must be taken prior to the analysis of the samples. Any individual compound that fails must be reported as estimated for detects and must have a demonstration of sensitivity to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only (%D criteria are not applied) but the standard qualitative identification criteria in the method must be met.

9.2.4.5.5 **CCV Poor Performers**: Refer to Attachment 1 for the identification of poor and/or erratic performing analytes. These analytes are allowed a %D >20% but must be <50 %D to be acceptable. If there are poor performers that exceed 50%D, the data may be reported provided results are noted as estimated. An NCM must be initiated to denote this situation.

9.2.4.5.6 The retention times of the internal standards from the calibration check must be within ±30 seconds of the internal standards from the mid point standard of the original calibration. If the retention time for any internal standard changes by more than 30 seconds from the latest daily (12 hour) calibration standard, the chromatographic system is inspected for malfunctions, and corrections made as required. If corrective action does not result in the retention time criteria being achieved, the system must be re-calibrated using four additional standards.

9.2.4.5.7 The response (area count) of each internal standard in the calibration verification standard must be within 50 - 100% of its corresponding internal standard in the mid-level calibration standard of the active calibration curve. If the EICP area for any internal standard changes by more than a factor of two (-50% +100%), the mass spectrometer system must be inspected for malfunction and corrections made as appropriate. When corrections are made, re-analysis of samples analyzed while the system was malfunctioning is required.

9.2.4.5.8 The relative retention times of each compound in the calibration verification standard must agree within .06 relative retention time units of its value in the initial calibration.

9.2.4.5.9 Use the average response factors from the original five-point calibration for quantitative analysis of target analytes identified in field samples.

9.2.4.5.10 Prepare a calibration summary or list indicating which compounds did not meet the 20% average percent difference criteria. Record this information in that run log.

9.2.4.7. **Low Level Continuing Calibration Verification (LLCCV):** An LLCCV consisting of the low level standard from the initial calibration range is analyzed every 12 hours of instrument operation after the CCV. The purpose and evaluation of the LLCCV is described in Section 9.2.4.4.4.

10.0 Procedure

10.1. Gas Chromatograph/Mass Spectrometer Operation

10.1.1. The sequence of events for GC/MS analysis involves many steps. First the injection system and column performance and calibration must be verified. Maintenance operations are performed as needed.

10.1.2. **Preparation of the Injection Port Liner and Installation Procedure**: Prior to the start of initial calibration and each daily analysis of sample extracts, a new liner for the injection port must be prepared. Once a liner has been used it is no longer inert and will cause serious chromatography problems with phenols and other compounds. When preparing the liner, proper laboratory protection must be worn and the liner must be prepared in a well-ventilated hood. When the procedure is completed all traces of toluene, Sylon-Ct and methanol will be removed immediately so that extraction solvents and preparation of sample extracts will not come into contact with these solvents and become contaminated.

10.1.2.1 Remove one liner from a 40ml VOA bottle containing other liners immersed in Sylon-Ct solution. Rinse off the liner with Toluene and wipe dry. Insert 1cm of pre-silanized glass wool partially into one end of the liner and trim neatly. Push the glass wool into the center of the liner so that it is 1 1/4" from the bottom. Do not use glass wool or solvents that are dirty (i.e. suspended particles) or use liners which are chipped on the ends, deformed or fractured. Inspect the glass wool for cleanliness after it has been inserted.

10.1.2.2 Using a Pasteur pipette flush out the interior of the liner containing the glass wool with Sylon-Ct. Rest the liner horizontally on a small beaker and allow the Sylon-Ct to re-deactivate the interior surfaces and the glass wool. There should be no air bubbles caught in the glass wool. After several minutes flush out the Sylon-Ct with toluene and finally with methanol. Dry the outer surface of the liner and rest it on the injection port housing until the remaining methanol is boiled off

10.1.2.3 Insert the liner with the newly silanized glass wool plug into the injection port. Verify that the column extends up into the injection port and is perpendicular. Inspect the graphite seal and replace it if the edges are knife-shaped.

10.1.2.4 The septum is always replaced daily. Bake out the column at 300°C for 15 minutes after the vacuum in the analyzer has returned to normal.

10.1.2.5 Performance may enhanced by clipping a small portion of the column at the injection port end. Document this activity in the maintenance record.

10.1.3. Prior to calibration or sample analysis always verify that the analyzer is under sufficient vacuum and that the column has proper carrier gas flow.

10.1.4. Establish the following GC/MS operating conditions:

10.1.4.1 Full Scan Operating Mode

Full Scan Mode – Standard Injection Volume
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.0 minutes
Initial Column Temperature and Hold Time: 45°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 5 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse, splitless
Injection Volume: 1ul
Splitless Valve Time: 0.3 minutes

Full Scan Mode – Large Volume Injection (LVI)
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.0 minutes
Initial Column Temperature and Hold Time: 45°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 5 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse, splitless
Injection Volume: 5ul
Splitless Valve Time: 0.3 minutes

10.1.4.2 SIM Operating Mode

SIM Mode
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.5 minutes
Initial Column Temperature and Hold Time: 40°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 3 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse splitless
Injection Volume: 1ul
Splitless Valve Time: 0.3 minutes

10.1.4.3 Isotope Dilution Selected Ion Monitoring Mode :

SIM Parameters

Group 1
Plot 1 Ion: 74.0

Ions/Dwell in Group	(Mass Dwell)	(Mass Dwell)	(Mass Dwell)
	42.0 50	43. 0 50	68.0 50
	74.0 50	128.0 50	129.0 50
	136.0 50	150.0 50	152.0 50
	93.0 50	66.0 50	
	58.0 50		
	88.0 50		

Group 2
Group Start Time: 6.00
Plot 1 Ion: 152.0

Ions/Dwell in Group	(Mass Dwell)	(Mass Dwell)	(Mass Dwell)
	151.0 50	152.0 50	153.0 50
	154.0 50	162.0 50	164.0 50
	165.0 50	166.0 50	

Group 3
Group Start Time: 7.80
Plot 1 Ion: 188.0

Ions/Dwell in Group	(Mass Dwell)	(Mass Dwell)	(Mass Dwell)
	94.0 50	101.0 50	142.0 50
	178.0 50	179.0 50	188.0 50
	202.0 50	264.0 50	266.0 50
	284.0 50		

Group 4
Group Start Time: 10.50
Plot 1 Ion: 228

Ions/Dwell in Group	(Mass Dwell)	(Mass Dwell)	(Mass Dwell)
	120.0 50	228.0 50	229.0 50
	240.0 50		

Group 5
Group Start Time: 12.00
Plot 1 Ion: 252.0

Ions/Dwell in Group	(Mass Dwell)	(Mass Dwell)	(Mass Dwell)
	138.0 50	139.0 50	252.0 50
	253.0 50	260.0 50	264.0 50
	267.0 50	276.0 50	278.0 50

Table 19: Target Compound - Primary and Monitoring Ions

Compound	1	2	3

Compound	1	2	3
1,4-Dioxane-d8	96	64	62
1,4-Dioxane	88	58	57
1,4-Dichlorobenzene-d4	152	150	

10.1.5. The above listed instrument conditions are used for all analytical standards for calibration and for all sample extracts analyzed by this method.

10.1.5.1 The column conditions, scan start time, and splitless valve time for analysis of DFTPP only are as follows are as follows:

Initial Column Temperature and Hold Time: 140°C for 0.5 minutes
Column Temperature Program: 140° to 320°C at 22°C/minute
Final Column Temperature Hold: 320C for 0.5 minutes
Scan Start Time: approx. 5 minutes
Splitless Valve Time: 0.3 minutes
Injection Volume: 2 ul

10.2. Analytical Sequence

10.2.1. Dilutions are made based on initial GC/MS analysis. Dilutions are made in 1-ml vials using microsyringes. Calculate the dilution factor using the equation below:

$$DF = Ph / 5 \times Is$$

Where:

DF = Dilution Factor
Ph = Sample Peak Height
Is = Internal Standard Peak Height

When DF >1 but <2, combine 500ul of sample extract with 500ul methylene chloride in a 1 ml amber vial, add20 ul internal standard and crimp seal

Use **Table 20** to determine dilution and internal standard amount.

Table 20
Dilution Factor Calculations

DF Value	Volume of Sample (ul)	Volume of Methylene Chloride (ul)	Volume of ISTD (ul)
<1	1,000	None	None
>1, <2	500	500	10
>4, <5	200	800	16
>10, <20	100	900	36
>20	500*	500	10
*Prepare this dilution by serially diluting the >10, <20 dilution			

10.2.2. Instrument Performance and Calibration Sequence

10.2.2.1. Once the GC/MS instrument has been setup and maintained as detailed in Section 10.1, the first operations to be performed are the performance checks and calibration standards.

10.2.2.2. Analyze the Instrument Performance Check Standard (DFTPP) as discussed in Section 9.2.1.

10.2.2.3. Initially and as required, analyze the Initial Calibration Range (minimum 5 points, six points for second order regression) as detailed in Sections 7.2.1 and 9.2.4.2. Evaluate the acceptability of the Initial Calibration Range as detailed in Section 9.2.4.2.

10.2.2.4. Immediately after the Initial Calibration Range only, analyze the Initial Calibration Verification (ICV) as detailed in Sections 7.2. and 9.2.4.3. Evaluate the acceptability of the ICV as detailed in Section 9.2.4.3.

10.2.2.5. Every 12 hours, reanalyze and evaluate the Instrument Performance Check Standard (DFTPP), not required for 8270E followed by the Continuing Calibration Verification (CCV) and Low Level Continuing Calibration Verification (LLCCV) as detailed in Section 9.2.3, 9.2.4.4 and 9.2.4.5. Evaluate the acceptability of the CCV and LLCCV as detailed in Section 9.2.4.4

10.2.2.6. Client samples and QC samples are analyzed (as detailed in Section 10.2.3) after acceptable Instrument Performance and Calibration Checks and until the 12 hour clock expires. Repeat the sequence as required. The automation of GC/MS runs is accomplished via the “SEQUENCE” macro of the ChemStation.

10.2.3. Sample Analysis Sequence

10.2.3.1. Sample extracts are normally prepared on the same day as analysis. The GC/MS operator will prepare the extracts that will be run on his or her instrument. Volume adjustments to the extracts will be made at the discretion of the supervisor.

10.2.3.2. Prior to the start of sample analysis the GC/MS operator will generate a sequence program containing the list of the sample extracts to be analyzed, the position on the autosampler tray, and the proper acquisition and tune methods that are to be used. This sequence program contains all the necessary information on the samples to be analyzed and how the GC/MS system is to analyze them. The sample extracts are loaded onto the autosampler (ALS) tray. Their position is verified by checking them against the ALS number on the sequence. This batch analysis will be performed automatically over the 12-hour period.

10.2.3.3. The analytical run log is printed as a record of samples analyzed. The analyst will annotate the run log with any required information regarding anomalies or unusual events. The run log must be signed by the analyst and a reviewed and signed by a trained peer or manager

10.3. Data Processing

10.3.1. Prior to processing any standards or samples, target compound lists and sublists must be assembled. Chrom's auto-processing system queries TALS (LIMS) for each sample's processing parameters (including target compounds lists) and downloads the required processing methods from LIMS to analyze data. These lists are required for processing of all data files including calibration files. The data includes compound names, retention time data, quantitation ions, qualitative identification ions, and the assigned internal standard for qualitative and quantitative identification.

10.3.2. Key data is manually entered the first time a compound list is used for data processing. Processing data using a compound list automatically generates response factor data and updates retention information.

10.3.3. The characteristic ions for target compounds, surrogate compounds, and internal standards which can be determined using SW 8270E are listed in Table 21.

10.4. Interpretation and Qualitative Identification: Qualitative identification of target compounds is based on retention time and mass spectral comparison with characteristic ions in the target compound list. The reference mass spectrum is taken from a standard of the target compound analyzed by this method. The characteristic ions are the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met:

10.4.1 **Target Analytes:** Qualitative identification of target compounds is based on retention time and mass spectral comparison with characteristic ions in the target compound list. The reference mass spectrum is taken from a standard of the target compound analyzed by this method. The characteristic ions are the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met:

10.4.1.1. Once the GC/MS instrument has been setup and maintained as detailed in Section 10.1, the first operations to be performed are the performance checks and calibration standards.

10.4.1.2. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other.

10.4.1.3. The relative retention time (RRT) of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

10.4.1.4. The most abundant ion in the standard target spectrum that equals 100% MUST also be present in the sample target spectrum.

10.4.1.5. All other ions that are greater than 10% in the standard target spectra should also be present in the sample.

10.4.1.6. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%).

10.4.1.7. If the compound does not meet all of the criteria listed above, but is deemed a match in the technical judgment of the mass spectral interpretation specialist, the compound will be positively identified and reported with documentation of the identification noted in the raw data record.

10.4.2 **Non-Target Analytes:** Upon client request a library search to identify non-target Tentatively Identified Compounds (TIC) is performed. The NIST/EPA/NIH mass spectral library is used to identify non-target compounds (not including internal standard and surrogate compounds) of greatest apparent concentration by a forward search of the library. The following guidelines are used by the analyst when making TIC identifications:

10.4.2.1. Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.

10.4.2.2. The relative intensities of the major ions should agree within ±20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%).

10.4.2.3. Molecular ions present in the reference spectrum should be present in the sample spectrum.

10.4.2.4. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.

10.4.2.5. Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.

10.4.2.6. If, in the technical judgement of the mass spectral interpretation specialist, no tentative identification can be made, the compound will be reported as 'Unknown'. If the compound can be further classified the analyst may do so (i.e, 'Unknown hydrocarbon', 'Unknown acid' , etc.).

10.5. Data Reporting

10.5.1. Final Report. The Chom data system automatically produces a data report consisting of hardcopy reports corresponding to specific data reporting requirements, which is uploaded to the TALS LIMS System for the report production group.

10.5.1.1. Total Ion Chromatogram. Full length chromatogram depicting the full length of the GC/MS acquisition.

10.5.1.2. Spectra of all detected target compounds. A page for each detected target compound spectra with a standard reference spectrum for comparison.

10.5.1.3. The calculations of the concentrations of each target compound in the sample, reported in units of ppb, ug/kg or ug/l.

10.5.1.4. Data summaries for each method blank indicating which samples were extracted with the indicated blank.

10.5.1.5. A copy of the initial calibration range together with the calibration verification report, and tune report.

10.5.1.6. Quality Control (QC) data report for each batch including surrogate recoveries, internal standard area summaries, LCS, MS/MSD and RPD summaries.

10.6. The low-level calibration standard establishes the reporting limit. All reported data must be at a concentration at or above the low concentration standard. Any quantitative values below the report limit must be qualified as estimated.

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11.0. Calculations/Data Reduction

11.1. **Target Compounds:** are quantitated using the internal standard method (see the formula in Section 11.3).

11.1.1. Identified target compounds are quantitated using the integrated abundance from the EICP of the primary characteristic ion. The internal standard used shall be the one nearest the retention time of the analyte).

11.1.2. The average response factor (RRF) from the initial calibration is used to calculate the target analyte concentration in client samples using the formula found in Section 11.3. See Section 9.2.4 for discussion of RRF.

11.1.3. Secondary ion quantitation is utilized only when there are sample interferences preventing use of the primary characteristic ion. If secondary ion quantitation is used an average relative response factor (RRF) must be calculated using that secondary ion.

11.2. **Non-Target Compounds (Tentatively Identified Compounds):** An estimated concentration for non-target (tentatively identified compounds) is calculated using the internal standard method (see formula in Section 11.3). For quantiation, the nearest eluting internal standard free of interferences is used. The procedure used for calculating the concentration of non-target compounds is the same as that used for target compounds (see Section 11.1) with the following revisions:

11.2.1. The total area count of the non-target compound is used for As (instead of the area of a characteristic ion).

11.2.2. The total area count of the chosen internal standard is used as Ais (instead of the area of a characteristic ion).

11.2.3. A RF on 1.0 is assumed.

11.2.4. The resulting concentration is qualified as estimated ('J') indicating the quantitative uncertainties of the reported concentration.

11.3. Internal Standard Calculation:

11.3.1. Aqueous Samples

$$\text{Concentration } (\mu g/L) = \frac{(As)(Cis)(D)}{(Ais)(RF)(Vs)\,(Vi)\,(1000)}$$

Where:

As = Area of the characteristic ion for the target analyte in the sample
Cis = Concentration of the internal standard (ug/L)
D = Dilution factor, if the sample or extract was diluted prior to analysis. If no dilution is performed, D = 1.
Vi = Volume of the extract injected (ul)
Ais = Area of the characteristic for the associated internal standard
RF = Average response factor from the initial calibration.
Vs = Volume of sample extracted (ml)

The 1000 in the denominator represents the number of ul in 1 ml.

11.3.2. Solid Samples

$$\text{Concentration } (\mu g/KG) = \frac{(As)(Cis)(D)(Vt)}{(Ais)(RF)(Ws)\,(Vi)\,(1000)}$$

Where:

As = Area of the characteristic ion for the target analyte in the sample
Cis = Concentration of the internal standard (ug/L)
D = Dilution factor, if the sample or extract was diluted prior to analysis. If no dilution is performed, D = 1.
Vi = Volume of the extract injected (ul)
Ais = Area of the characteristic for the associated internal standard
RF = Average response factor from the initial calibration.
Vt = Volume of concentrated extract (ul)
Ws = Weight of sample (g)

The 1000 in the denominator represents the number of ul in 1 ml.

11.4. Relative Response Factors

$$RRF = \frac{A_x}{A_{is}} \times \frac{C_{is}}{C_x}$$

Where:

A_x = Area characteristic ion for the compound (see Table 21)
Ais = Area characteristic ion of associated internal std (See Table 21)
Cis = Concentration of internal standard
Cx = Concentration of compound in standard

11.5. Percent Relative Standard Deviation (% RSD) : as discussed in Section 9.2.4.4 (Initial calibration):

$$\% \text{ RSD} = \frac{\text{Standard Deviation of RRFs}}{\text{Mean RRF}}$$

11.6. Percent Difference (% D):as discussed in Section 9.2.4.4 (Continuing calibration):

$$\% \text{ D} = \frac{RRF_c - \overline{RRF_i}}{\overline{RRF_i}} \text{ X } 100$$

Where: RRFc = RRF from continuing calibration

$\overline{RRF_i}$ = Mean RRF from current initial calibration

11.7. Percent Recovery (% R): Surrogates and Spikes

$$\text{Recovery (\%)} = \frac{\text{Concentration (or amount) found}}{\text{Concentration (or amount) added}} \times 100$$

11.8. Calculation of Relative Standard Error (RSE)

$$\% RSE = 100\% \times \sqrt{\frac{\sum_{i=1}^{N}\left[\frac{C_i - PC_i}{C_i}\right]^2}{(N-P)}}$$

Where:

N = Number of points in the curve
P = Number of parameters in the curve (= 1 for average response factor, 2 for linear, 3 for quadratic)
CI = True concentration for level i
PCi = Predicted concentration for level

11.9. Calculation of Percent (%) Error

$$\%Error = \frac{x_i - x_i'}{x_i} x\, 100$$

Where:

x_i^1 = Measured amount of analyte at calibration level *i*, in mass or concentration units
x_i = True amount

11.10. Dry Weight Correction: All solid samples must be corrected for dry weight using the following formula for dry weight determination.

$$DW = \frac{Gd}{Gw} \text{ x } 100$$

Where:
DW = Percent % Dry Weight
Gd = Dry weight of selected sample aliquot
Gw = Wet weight of selected sample aliquot

Multiply the DW value times the wet weight of the sample extracted. NOTE: This calculation can also be performed automatically by the target system provided the DW value is available and entered into the system.

12.0. Method Performance

12.1. Method Detection Limit Study (MDL)

A Method Detection Limit (MDL) study, as described in the Eurofins corporate Detection and Quantitation Limits SOP, CA-Q-S-006, must be performed initially and whenever a significant change affecting sensitivity is made to the analytical system. The MDL must be re-evaluated from quarterly MDL points at least every 12 months.

12.2. Demonstration of Capabilities

For DOC procedure refer to Section 19 in the most current revision of Eurofins Edison's Quality Assurance Manual (ED-QA-LQM).

12.3. Lower Limit of Quantitation Verification

The lowest calibration standard analyzed establishes the LLOQ or Reporting Limit. The capability to reliably detect this concentration through the preparation, cleanup and analytical procedure is verified through the annual analysis of a standard at the LLOQ/RL. The LLOQ verification shall also be performed whenever significant changes are made to the preparation and/or analytical procedure.

12.3.1 The LLOQ verification standard shall be prepared at a concentration 0.5-2 times the LLOQ/RL, and be taken through all of the same preparation and clean-up methods as client samples.

12.3.2 The LLOQ verification standard for aqueous matrix shall be prepared using laboratory deionized water and for the solid matrix using clean Ottawa sand. Other clean matrices may be used in addition, for project specific requirements.

12.3.3 The annual LLOQ verification is completed and documented with the required annual MDL evaluation.

12.3.4 Recovery of each analyte must meet the laboratory established LCS recovery limits + 20%. (For example, if the LCS recovery limits are 70-130%, the LLOQ verification must meet recovery limits of 50-150%.) Once sufficient points have been generated, LLOQ based statistical limits may be used in place of limits based on LCS recovery.

NOTE: The lower recovery limit for the LLOQ can be no lower than 10%.

12.4. Training Requirements

Refer to Eurofins SOP No. ED-GEN-022, (*Training*), for the laboratory's training program.

13.0. Pollution Control

13.1 It is Eurofins's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Environmental Health and Safety Manual (CW-E-M-001) for "Waste Management and Pollution Prevention."

14.0. Waste Management

14.1 Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to Eurofins Edison SOPs Nos. ED-SPM-007 (*Disposal of Samples and Associated Laboratory Waste, current revision)* and ED-SPM-008 (*Laboratory Waste Disposal Procedures, current revision).* The following waste streams are produced when this method is carried out:

- Auto sampler vials and expired standards: These vials are collected in satellite accumulation within the instrument laboratory. The vials are then placed into a 55 steel open top drum in the waste room. When the drums are full, the drum will be collected by the waste vendor for disposal. This waste is treated for incineration.

  Teris Profile Number: 50016652
  Onyx Profile WIP Number: 282493

- Mixed Solvent Waste: Mixed solvent waste is collected in a small beaker inside the bench top hood. This waste is then transferred into the satellite accumulation container in the Organic Prep. Lab. on a daily basis. This material is transferred into 5 gallon solvent cans as satellite accumulation. These cans are emptied every 24 hours into a steel drum in the waste room. This drum is kept in the walk in hood until it is full. The full drum is then removed from the hood and placed on secondary containment in the waste room.

  Teris Profile Number: 50016624
  Onyx Profile WIP Number: 545240

14.1. Pollution Prevention

14.2.1. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The USEPA has established a prevention hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

14.2.2. The quantity of chemical purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

15.0. References / Cross-References

15.1. United States Environmental Protection Agency, “Method SW8270D, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry”, Test Methods for Evaluating Solid Wastes, SW846 Third Edition, Laboratory Manual, Physical/Chemical Methods, Revision 5, July 2014..

15.2. United States Environmental Protection Agency, “Method SW8270E, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry”, Test Methods for Evaluating Solid Wastes, SW846 Update IV, Laboratory Manual, Physical/Chemical Methods, Revision 6, June 2018.

15.3. United States Environmental Protection Agency, “Method SW8000D: Determinative Chromatographic Separations”, Test Methods for Evaluating Solid Wastes, SW846, Laboratory Manual, Physical/Chemical Methods, Update V, Revision 4, October 2012..

15.4. Eurofins Edison Document No. ED-QA-LQM, *Laboratory Quality Manual*, current revision.

15.5. Eurofins Edison SOP No. ED-ORP-002, *SW846 Method 3510C-Extraction of Semi-Volatile Organic Compounds in Water by Separatory Funnel,* current revision.

15.6. Eurofins Edison SOP No. ED-ORP-043, *SW846 Method 3580A - Waste Dilution Prep for Analysis of BNAs by SW846 Method 8270,* current revision.

15.7. Eurofins Edison SOP No. ED-ORP-044, *Procedure for the Microwave Extraction of Solids, SW3546, current revision.*

15.8. Eurofins Document No. CW-E-M-001, Corporate Environmental Health and *Safety Manual,* current revision.

15.9. Eurofins Corporate Quality SOP No. CA-Q-S-001, *Solvent & Acid Lot Testing & Approval*, current revision.

15.10. Eurofins Edison SOP No. ED-GEN-023 (*Bulk Solvent Testing and Approval*), current revision.

15.11. Eurofins Edison SOP No. ED-GCS-001, *Preparation and Screening of Semivolatile Organic Extracts for GC/MS Analysis*, current revision.

15.12. Eurofins Edison Work Instruction Document No. EDS-WI-012, *Client Complaint/Corrective Action Form,* current revision.

15.13. Eurofins Edison SOP No. ED-GEN-003, *Standard Operating Procedure for Control of Non-Conformances and Corrective Action,* current revision.

15.14. Eurofins Edison SOP No. ED-ORP-001, *Extraction of Semivolatile Organic Compounds in Water, EPA Method 625.1,* current revision.

15.15. Eurofins Edison SOP No. ED-GEN-022, *Training,* current revision.

15.16. Eurofins Corporate Quality Memorandum, CA-Q-QM-002, *GC/MS Tuning Policy*, current revision.

15.17. Eurofins Corporate Quality SOP No. CA-Q-S-006, *Detection and Quantitation Limits,* current revision.

16.0. Method Modifications:

Method 8270E requires the DFTPP tune standard to be analyzed once prior to an ICAL and not daily prior to sample analysis. Until such time as 8270D is removed from lab capabilities and in order to satisfy both 8270D and 8270E The laboratory will analyze the DFTPP tune daily, prior to QC and sample analysis. The laboratory will use the tighter criteria from Methods 8270C/8270D for tune evaluation, rather than the criteria suggested in Table 3 of Method 8270E.

17.0. Attachments

Attachment 1 Poor Performing Analytes

18.0. Revision History

- Revision 10, date 10/18/2022
    - Updated to Eurofins branding throughout.
    - Section 8.1: updated to include procedure for sampling chlorinated water sources.
    - Section 9 updated throughout to include ICAL evaluation with Relative Standard Error (RSE).
    - Section 11.8: added formula for calculation of Relative Standard Error (RSE)

- Revision 9, date 03/15/2021
    - Updated as needed to reflect 1,4-dioxane RL of 0.2 ug/l.
    - Updated Tables 11 and 12 to reflect new low ICAL standard concentration of 1,4-dioxane..

- Revision 8, date 06/29/2020
    - Updated to Eurofins branding.
    - Updated throughout to include 8270E requirements.
    - Removed references to SW846 3550B/C prep methods (no longer in use for this method at Edison lab).
    - Update equipment listed in Section 6.0.Updated analytical column in Section 6.1.2.
    - Updated, deleted and renumbered tables as required.
    - Made extensive updates to Standards (sources and preparation) in Section 7.2.
    - Removed all references to Aromatic Amines. Deleted all tables specific to Aromatic Amine analysis. Renumbered remaining tables in document and updated text references.
    - Throughout document clarified tune requirements for 8270E.
    - Following added to Section 9.1.1: For method 8270E the method blank is generally acceptable if target analyte concentrations are less than the one half the reporting limit.
    - Calibration Point Read-back Criteria was added to Section 9.2.4.3. The calculation for percent error was added to Section 11.8.
    - Section 9.2.4.2.3: added following for 8270E: the calculated concentration or amount of each analyte of interest in the CCV standard should fall within ±20%.
    - Section 9.2.4.2.5.6: added ‘The recalculated concentration of the low calibration point should be within ±50% of the standard’s concentration.”

  - Section 12.1 revised to reflect the updated MDL procedure.
  - Added Section 12.3: annual Lower Limit of Quantitation Verification
  - Added Corporate SOP CA-Q-S-006, Detection and Quantitation Limits to references.
  - Section 16.0: added a Method Modification regarding tuning check requirements.

- Revision 7, date 06/08/2018

  - Section 2.3: revised to clarify that RVE/LVI is lab standard procedure.
  - Section 9.1.3: removed statement regarding allowance for up to five analytes to recover outside of lab acceptance limits in LCS/LCSD.
  - Section 9.2.4.3: Replace table 'ICV Poor Performers (50-150% Recovery) with expanded list of 'Poor Performing Analytes' in Attachment 1.
  - Added Section 9.2.4.4.5: CCV Poor Performers
  - Corrected number in section 9.2.4.5
  - Added Attachment 1 – Poor Performing Analytes

- Revision 6, date 01/12/2018:

  - Section 7.2.5 included to specify reagent and standard storage conditions.
  - Revised Section 9.1.3 to clarify requirements for specific LCS/LCSD evaluation criteria regarding the # of out of criteria analytes.
  - Revised Section 9.2.4.3 to add 2,4-Dimethylphenol as a poor performing analyte, increased the range for the poor performers to 50-150 and also expanded the guidelines for flagging the ICV outliers.

- Revision 5, dated 09/29/2017:
  - Revised Section 9.1.1 to clarify requirements for surrogate recovery in method blanks.

- Revision 4, dated 08/21/2017:
  - Updated throughout to add a procedure for the analysis of 1,4-dioxane by isotope dilution selected ion monitoring (SIM)
  - Added tables for isotope dilution SIM standards. Renumbered all tables as necessary.
  - Section 7.2.1: added a list of full scan calibration list options.
  - Table 3: Renamed 'Full Scan Stock Standards'.
  - Section 9.2.1: noted that DFTTP applies only to full scan analysis.
  - Section 9.2.3: updated CCV concentrations
  - Added reference to GC/MS Tuning Policy in Section 15.16.

- Revision 3, dated 01/07/2016:
  - Tables 1 and 2: added SIM as option for 1,4-Dioxane.
  - Section 2.3: removed SW3541 (Soxtherm) as option for soils prep (lab has discontinued use of this method). Also removed SW3541 SOP reference from Section 15.0.
  - Tables 19 and 20: added source and prep instructions for 1,4-Dioxane SIM standard. Updated source and prep instructions for 4,6-Dinitro-2-methylphenol.
  - Table 22: added prep instructions for 1,4-Dioxane and 4,6-Dinitro-2-methylphenol

SIM ICV standard.

  - Corrected the information in the 'DFTPP Key Ions and Abundance Criteria' table in Section 9.2.1 to match the info found in SW846 8270C.
  - Section 10.1.4.2: updated "SIM Parameters" to included ion masses/dwell times for 1,4-Dioxane.

- Revision 2, dated 01/28/2015:
  - Extensively reformatted the SOP. Placed tables that had been in rear of document into the body of the text. Renumbered tables as applicable and fixed text references to tables.
  - Section 1.1, Table 1: Revised table to include all current analytes. Also footnoted those compounds which are currently analyzed by SIM.
  - Section 2.3: added options for extraction of solids by SW846 3456 (Microwave Extraction) and by SW3580A (Waste Dilution) and added SOP references. Deleted reference to SOP ED-ORP-005 (SW3550B – Low Level); Updated Section 15 (References).
  - Section 2.5: added text detailing the RVE/LVI options.
  - Section 2.6: added table which includes all analytes routinely analyzed by SIM.
  - Section 6: updated to include newer GC, MS and autosampler models currently in use.
  - Section 6.1.3: added Zebron ZB column as an option.
  - Section 7.2: extensively revised standards information to reflect switch to Restek standards.
  - Table 3:Added Custom Aromatic Amine Surrogate Standard and revised Table 8 to include initial calibration prep instructions for the Aromatic Amine surrogates.
  - Throughout document: removed references to Target and replaced with Chrom.
  - Section 7.2.1: Added reference to section 10.2.1.2 for LVI.
  - Added Section 7.2.1.3.1 and Table 17A both of which discuss use of Aromatic Amine surrogates.
  - Section 7.2.1.2: Added reference to Tables 9,10 and 11 (ICV Preparation)
  - Section 8.0: Added Sample container and minimum sample size (250 ml) for Reduced volume extraction.
  - Sections 9.1.2, 9.1.3, 9.1.4 and 9.2.4: added statement that certain state regulatory programs have defined recovery limits which, where applicable, are used for spike and calibration evaluations.
  - Section 9.1.2: Deleted sentence "A minimum of 16 spiked analytes are reported to in client reports (the full list is reported at least once during each 2 year period because we employ full spiking list.
  - Section 9.1.4: Added note regarding use of Aromatic Amine Surrogates.
  - Section 9.2.2.2: Added reference to ICV Preparation tables in Section 7.2.
  - Section 9.2.3: added more specific info as to the concentration of the CCVs for all techniques.
  - Section 9.2.4.2.1: Changed to reflect that each analyte should meet minimum RF's, not the average across the calibration. Added LLCCV requirement.
  - Section 10.3.1: added explanation of Chrom's interaction with TALS. Removed references to Target.
  - Section 9.2.4.2.5.5: Added: (or can be noted in the narrative)
  - Section 9.2.4.2.5.6: Revised last sentence to read: "This evaluation can be checked using the Initial Calibration %Drift Report in Chrom."
  - Section 9.2.4.3: Removed 65-135% criteria and added "poor performing" analyte list and associated criteria of 60-140%.

  - Section 9.2.4.4.3: Added LLCCV criterion for RFs
  - Section 9.2.4.4.4: Added LLCCV criterion for %D
  - Section 10.1.4: Updated GC/MS operating conditions for full scan, SIM and DFTPP.
  - Section 10.1.4.1: added a table detailing operating conditions for LVI option.
  - Table 2: Added 2-ethylaniline, 2,4-dimethylaniline, 3,4-dimethylaniline, 2,3-dimethylaniline, 2,4,5-trimethylaniline and 4-chloro-o-toluidine to Working Standards preparation information.
  - Table 25: updated to include all current analytis/surrogates/internal standards and associated ions.
  - Throughout document: updated LQM section references as appropriate as some have changed with the latest LQM revision.

- Revision 1, dated 11/07/2011

  - Section 1.1, Table 1: Added Pentachloronitrobenzene and associated CAS# to the analyte list.
  - Section 7.2.1: Added Pentachloronitrobenzene standard information.
  - Table 2: Added Pentachloronitrobenzene to Working Standards preparation information.
  - Table 4: Added Pentachloronitrobenzene and associated minimum RF.
  - Table 8: Added Pentachloronitrobenzene and associated ions.

- Revision 0, dated 02/22/2011: NEW

Table 21
Characteristic Ions Of Semi-Volatile Organic Compounds

Compound	Primary Ion	Secondary Ion(s)
1,1'-Biphenyl	154	153,76
1,2,4,5-Tetrachlorobenzene	216	214, 179
1,2,4-Trichlorobenzene	180	182, 145
1,2-Dichlorobenzene	146	148, 111
1,2-Diphenylhydrazine	77	105, 182
1,3-Dichlorobenzene	146	148, 111
1,3-Dimethylnaphthalene	156	141, 115
1,4-Dichlorobenzene	146	148, 111
1,4-Dichlorobenzene d4 **(ISTD)**	152	150, 115
1,4-Dioxane	88	58, 43
1-Methylnaphthalene	142	141, 115
1-Naphthylamine	143	115, 116
2,2'-oxybis[1-chloropropane]	45	77, 121
2,3,4,6-Tetrachlorophenol	232	131, 230
2,3,7,8-TCDD (screen)	320	322, 324
2,3-Dihydroindene		
2,3-Dimethylaniline	106	129

Table 21 Characteristic Ions Of Semi-Volatile Organic Compounds		
Compound	**Primary Ion**	**Secondary Ion(s)**
2,4,5-Trichlorophenol	196	198, 200
2,4,5-Trimethylaniline	102	55, 56
2,4,6-Tribromophenol **(Surrogate)**	330	132, 141
2,4,6-Trichlorophenol	196	198, 200
2,4-Dichlorophenol	162	164, 98
2,4-Xylidine	121	120, 106
2,4-Dimethylphenol	122	107, 121
2,4-Dinitrophenol	184	63, 154
2,4-Dinitrotoluene	165	63, 89
2,6-Dinitrotoluene	165	63, 89
2-Chloronaphthalene	162	127, 164
2-Chlorophenol	128	64, 130
2-Ethylaniline	106	122,104
2-Fluorobiphenyl **(Surrogate)**	172	171
2-Fluorophenol **(Surrogate)**	112	64
2-Methylnaphthalene	142	141
2-Methylphenol	108	107
2-Naphthylamine	143	115, 116
2-Nitroaniline	65	108, 138
2-Nitrophenol	139	109, 65
2-tert-butyl-4-Methylphenol	149	121, 91
2-Toluidine	107	106, 77
3,3'-Dichlorobenzidine	252	254, 126
3,4-Dimethylaniline	106	129, 127
3,5-Di-tert-butyl-4-Hydroxytol	205	220, 145
3-Nitroaniline	138	108, 65
4,6-Dinitro-2-methylphenol	198	51, 105
4-Bromophenyl phenyl ether	248	250, 141
4-chloro-2-methylaniline	106	144, 142
4-Chloro-3-methylphenol	107	144, 142
4-Chloroaniline	127	129
4-Chloroaniline-d4 **(Surrogate)**	131	133
4-Chlorophenyl phenyl ether	204	206, 141
4-Methylphenol	108	107
4-Nitroaniline	138	108, 65
4-Nitrophenol	139	109, 65
Acenaphthene	154	153, 152
Acenaphthene d10 **(ISTD)**	164	162, 160
Acenaphthylene	152	151, 153
Acetophenone	105	77, 51
Aniline	93	66
Aniline-d5 **(Surrogate**)	98	71,42
Anthracene	178	176, 179
Atrazine	200	173,215
Benzaldehyde	77	105,106
Benzidine	184	92, 185

Table 21
Characteristic Ions Of Semi-Volatile Organic Compounds

Compound	**Primary Ion**	**Secondary Ion(s)**
Benzo(a)anthracene	228	229, 226
Benzo(a)pyrene	252	253, 125
Benzo(b)fluoranthene	252	253, 125
Benzo(g,h,i)perylene	276	138, 277
Benzo(k)fluoranthene	252	253, 125
Benzoic Acid	122	105, 77
Benzyl Alcohol	108	79, 77
Bis(2-chloroethoxy)methane	93	95, 123
Bis(2-chloroethyl)ether	93	63, 95
Bis(2-ethylhexyl)phthalate	149	167, 279
Bisphenol-A	213	228, 119
Butyl benzyl phthalate	149	91, 206
Caprolactam	113	55,56
Carbamazepine	193	236, 135
Carbazole	167	166, 139
Chrysene	228	226, 229
Chrysene d12 **(ISTD)**	240	120, 136
Coumarin	146	118, 63
Dibenz(a,h)anthracene	278	139, 279
Dibenzofuran	168	139
Diethylphthalate	149	177, 150
Dimethylphthalate	163	194, 164
Di-n-butylphthalate	149	150, 104
Di-n-octylphthalate	149	167, 43
Fluoranthene	202	101, 203
Fluorene	166	165, 167
Hexachlorobenzene	284	142, 249
Hexachlorobutadiene	225	223, 227
Hexachlorocyclopentadiene	237	235, 272
Hexachloroethane	117	201, 199
Indeno(1,2,3-cd)pyrene	276	138, 227
Isophorone	82	95,138
Kepone	272	237, 355
N,N-Dimethylaniline	120	122, 104
Naphthalene	128	129, 127
Naphthalene d8 **(ISTD)**	136	68
n-decane	43	57
Nitrobenzene	77	123, 65
Nitrobenzene-d5 **(Surrogate)**	82	128, 54
N-Nitrosodimethylamine	42	74, 44
N-Nitroso-di-n-propylamine	170	42,101,130
N-Nitrosodiphenylamine	169	168, 167
n-Octadecane	57	43, 85
o-Toluidine-d9 **(Surrogate)**	114	112, 42
Pentachloronitrobenzene	237	214,295
Pentachlorophenol	266	264, 268

Table 21 Characteristic Ions Of Semi-Volatile Organic Compounds		
Compound	**Primary Ion**	**Secondary Ion(s)**
Perylene d12 **(ISTD)**	264	260, 265
Phenanthrene	178	179, 176
Phenanthrene d10 **(ISTD)**	188	94, 80
Phenol	94	65, 66
Phenol-d5 **(Surrogate)**	99	42, 71
Phenyl ether	170	77, 115
Pyrene	202	200, 203
Pyridine	79	52, 51
Terphenyl-d14 **(Surrogate)**	244	122, 212

Attachment 1
Poor Performing Compounds

1,2,4,5-Tetrachlorobenzene
1,4-Dioxane
1-Naphthylamine
2,3,4,6-Tetrachlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2-Chloroaniline
2-Naphthylamine
3&4-Methylphenol
3’3-Dichlorobenzidine
4,6-Dinitro-2-methyl- phenol
4-Chloroaniline
4-Nitrophenol
Aniline
Atrazine
Benzaldehyde
Benzidine
Benzoic Acid
Benzyl Alcohol
Biphenyl
Caprolactam
Diphenylamine
Hexachlorocyclopentadiene
Hexachloroethane
n-Decane
n-Nitrosodimethylamine
o,o,o-Triethylphosphorothioate
o-Toluidine
Pentachloronitrobenzene
Pentachlorophenol
Phenol
Pyridine

These analytes are exempt from the ICV and CCV criteria as detailed in this SOP

Quality Assurance Project Plan/Field Sampling Plan

268 Bergen Street, 287 Wyckoff Street and N/A Wyckoff Street, Brooklyn, New York

ATTACHMENT 3

Roux's Standard Operating Procedures

Date: May 5, 2000

1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for decontamination of all field equipment potentially exposed to contamination during drilling, and soil and water sampling. The objective of decontamination is to ensure that all drilling, and soil-sampling and water-sampling equipment is decontaminated (free of potential contaminants): 1) prior to being brought onsite to avoid the introduction of potential contaminants to the site; 2) between drilling and sampling events/activities onsite to eliminate the potential for cross-contamination between boreholes and/or wells; and 3) prior to the removal of equipment from the site to prevent the transportation of potentially contaminated equipment offsite.

In considering decontamination procedures, state and federal regulatory agency requirements must be considered because of potential variability between state and federal requirements and because of variability in the requirements of individual states. Decontamination procedures must be in compliance with state and/or federal protocols in order that regulatory agency(ies) scrutiny of the procedures and data collected do not result in non acceptance (invalidation) of the work undertaken and data collected.

2.0 PROCEDURE FOR DRILLING EQUIPMENT

The following is a minimum decontamination procedure for drilling equipment. Drilling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

2.1 The rig and all associated equipment should be properly decontaminated by the contractor before arriving at the test site.

2.2 The augers, drilling casings, rods, samplers, tools, rig, and any piece of equipment that can come in contact (directly or indirectly) with the soil, will be steam cleaned onsite prior to set up for drilling to ensure proper decontamination.

2.3 The same steam cleaning procedures will be followed between boreholes (at a fixed on-site location[s], if appropriate) and before leaving the site at the end of the study.

2.4 All on-site steam cleaning (decontamination) activities will be monitored and documented by a member(s) of the staff of Roux Associates, Inc.

2.5 If drilling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat drilling equipment, then special decontamination procedures may have to be utilized before steam cleaning (e.g., hexane scrub and wash).

2.6 Containment of decontamination fluids may be necessary (e.g., rinseate from steam cleaning) or will be required (e.g., hexane), and disposal must be in accordance with state and/or federal procedures.

3.0 PROCEDURE FOR SOIL-SAMPLING EQUIPMENT

The following is a minimum decontamination procedure for soil-sampling equipment (e.g., split spoons, stainless-steel spatulas). Soil-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

3.1 Wear disposable gloves while cleaning equipment to avoid cross-contamination and change gloves as needed.

3.2 Steam clean the sampler or rinse with potable water. If soil-sampling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat sampling equipment, then special decontamination procedures may have to be utilized before steam cleaning and washing in detergent solution (e.g., hexane scrub and wash).

3.3 Prepare a non-phosphate, laboratory-grade detergent solution and distilled or potable water in a clean bucket.

3.4 Disassemble the sampler, as necessary and immerse all parts and other sampling equipment in the solution.

3.5 Scrub all equipment in the bucket with a brush to remove any adhering particles.

3.6 Rinse all equipment with copious amounts of potable water followed by distilled or deionized water.

3.7 Place clean equipment on a clean plastic sheet (e.g., polyethylene)

3.8 Reassemble the cleaned sampler, as necessary.

3.9 Transfer the sampler to the driller (or helper) making sure that this individual is also wearing clean gloves, or wrap the equipment with a suitable material (e.g., plastic bag, aluminum foil.

As part of the decontamination procedure for soil-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

4.0 PROCEDURE FOR WATER-SAMPLING EQUIPMENT

The following is a decontamination procedure for water-sampling equipment (e.g., bailers, pumps). Water-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

4.1 Decontamination procedures for bailers follow:

a. Wear disposable gloves while cleaning bailer to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a bucket.

c. Disassemble bailer (if applicable) and discard cord in an appropriate manner, and scrub each part of the bailer with a brush and solution.

d. Rinse with potable water and reassemble bailer.

e. Rinse with copious amounts of distilled or deionized water.

f. Air dry.

g. Wrap equipment with a suitable material (e.g., clean plastic bag, aluminum foil).

h. Rinse bailer at least three times with distilled or deionized water before use.

4.2 Decontamination procedures for pumps follow:

a. Wear disposable gloves while cleaning pump to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a clean bucket, clean garbage can, or clean 55-gallon drum.

c. Flush the pump and discharge hose (if not disposable) with the detergent solution, and discard disposable tubing and/or cord in an appropriate manner.

d. Flush the pump and discharge hose (if not disposable) with potable water.

e. Place the pump on clear plastic sheeting.

f. Wipe any pump-related equipment (e.g., electrical lines, cables, discharge hose) that entered the well with a clean cloth and detergent solution, and rinse or wipe with a clean cloth and potable water.

g. Air dry.

h. Wrap equipment with a suitable material (e.g., clean plastic bag).

As part of the decontamination procedure for water-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

STANDARD OPERATING PROCEDURE 5.1
FOR COLLECTION OF SOIL SAMPLES
FOR LABORATORY ANALYSIS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis. This SOP is applicable to soil samples collected from split-spoon samplers during drilling, hand auger samples, grab samples from stockpiled soils, surface samples, test pit samples, etc.

2.0 CONSIDERATIONS

Soil samples may be collected in either a random or biased manner. Random samples can be based on a grid system or statistical methodology. Biased samples can be collected in areas of visible impact or suspected source areas. Soil samples can be collected at the surface, shallow subsurface, or at depth. When samples are collected at depth the water content should be noted, since generally “soil sampling” is restricted to the unsaturated zone. Equipment selection will be determined by the depth of the sample to be collected. A thorough description of the sampling locations and proposed methods of sample collection should be included in the work plan.

Commonly, surface sampling refers to the collection of samples at a 0 to 6 inch depth interval. Certain regulatory agencies may define the depth interval of a surface sample differently, and this must be defined in the work plan. Collection of surface soil samples is most efficiently accomplished with the use of a stainless steel trowel or scoop. For samples at greater depths a decontaminated bucket auger or power auger may be needed to advance the hole to the point of sample collection. Another clean bucket auger should then be used to collect the sample. To collect samples at depths of greater than approximately six feet the use of a drill rig and split spoon samples will usually be necessary. In some situations, sample locations are accessed with the use of a backhoe.

3.0 MATERIALS/EQUIPMENT

a. A work plan which outlines soil sampling requirements.

b. Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.

c. Decontamination supplies (including: non-phosphate, laboratory grade detergent, buckets, brushes, potable water, distilled water, regulatory-required reagents, aluminum foil, plastic sheeting, etc.).

d. Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

e. Stainless steel spoons or spatulas.

f. Disposable sampling gloves.

g. Laboratory-supplied sample containers with labels.

h. Cooler with blue or wet ice.

i. Plastic sheeting.

j. Black pen and indelible marker.

k. Zip-lock bags and packing material.

l. Tape measure.

m. Paper towels or clean rags.

n. Masking and packing tape.

o. Overnight (express) mail forms.

4.0 DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to the decontamination SOP. Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and plastic sheeting will be changed after each use and discarded in an appropriate manner.

5.0 PROCEDURE

5.1 Prior to collecting soil samples, ensure that all sampling equipment has been thoroughly cleaned according to the decontamination SOP. If samples are to be collected at depth, then the boring must be advanced with thoroughly cleaned equipment to the desired sampling horizon and a different thoroughly cleaned sampler must be used to collect the sample.

5.2 Using disposable gloves and a pre-cleaned, stainless steel spatula or spoon, extract the soil sample from the sampler, measure the recovery, and separate the wash from the true sample. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.

5.3 Place the sample in a laboratory-supplied, pre-cleaned sample container. This should be done as quickly as possible and this is especially important when sampling for volatile organic compounds (VOCs). Samples to be analyzed for VOCs must be collected prior to other constituents.

5.4 The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials.

5.5 Using the remaining portion of soil from the sampler, log the sample in detail and record sediment characteristics (color, odor, moisture, texture, density, consistency, organic content, layering, grain size, etc.).

5.6 If soil samples are to be composited in the field, then equal portions from selected locations will be placed on a clean plastic sheet and homogenized. Alternately, several samples may be submitted to the laboratory for compositing by weight. The method used is dependent upon regulatory requirements. Specific compositing procedures shall be approved by the appropriate regulatory agency and described in the work plan. Samples to be analyzed for VOCs will not be composited unless required by a regulatory agency.

5.7 After the sample has been collected, labeled, and logged in detail, it is placed in a zip-lock bag and stored in a cooler at 4°C.

5.8 A chain-of-custody form is completed for all samples collected. One copy is retained and two are sent with the samples in a zip-lock bag to the laboratory. A custody seal is placed on the cooler prior to shipment.

5.9 Samples collected from Monday to Friday are to be delivered to the laboratory within 24 hours of collection. If Saturday delivery is unavailable, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if any analytes require a shorter delivery time.

5.10 The field notebook and appropriate forms should include, but not be limited to the following: client name, site location, sample location, sample depth, sample identification, date and time collected, sampler’s name, method of sample collection, number and type of containers, geologic description of material, description of decontamination procedures, etc. A site map should be prepared with exact measurements to each sample location in case follow-up sampling is necessary.

5.11 All reusable sampling equipment must be thoroughly cleaned in accordance with the decontamination SOP. Following the final decontamination (after all samples are collected) the sampling equipment is wrapped in aluminum foil. Discard any gloves, foil, plastic, etc. in an appropriate manner that is consistent with site conditions.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for sample handling which will allow consistent and accurate results. Valid chemistry data are integral to investigations that characterize media-quality conditions. Thus, this SOP is designed to ensure that once samples are collected, they are preserved, packed and delivered in a manner which will maintain sample integrity to as great an extent as possible. The procedures outlined are applicable to most sampling events and any required modifications must be clearly described in the work plan.

2.0 CONSIDERATIONS

Sample containers, sampling equipment decontamination, quality assurance/quality control (QA/QC), sample preservation, and sample handling are all components of this SOP.

2.1 Sample Containers

Prior to collection of a sample, considerations must be given to the type of container that will be used to store and transport the sample. The type and number of containers selected is usually based on factors such as sample matrix, potential contaminants to be encountered, analytical methods requested, and the laboratory's internal quality assurance requirements. In most cases, the overriding considerations will be the analytical methodology, or the state or federal regulatory requirements because these regulations generally encompass the other factors. The sample container selected is usually based on some combination of the following criteria:

a. Reactivity of Container Material with Sample

Choosing the proper composition of sample containers will help to ensure that the chemical and physical integrity of the sample is maintained. For sampling potentially hazardous material, glass is the recommended container type because it is chemically inert to most substances. Plastic containers are not recommended for most hazardous wastes because the potential exists for contaminants to adsorb to the surface of the plastic or for the plasticizer to leach into the sample.

In some instances, however, the sample characteristics or analytes of interest may dictate that plastic containers be used instead of glass. Because some metals species will adhere to the sides of the glass containers in an aqueous matrix, plastic bottles (e.g., nalgene) must be used for samples collected for metals analysis. A separate, plastic container should accompany glass containers if metals analysis is to be performed along with other analyses. Likewise, other sample characteristics may dictate that glass cannot be used. For example, in the case of a strong alkali waste or hydrofluoric solution, plastic containers may be more suitable because glass containers may be etched by these compounds and create adsorptive sites on the container's surface.

b. Volume of the Container

The volume of sample to be collected will be dictated by the analysis being performed and the sample matrix. The laboratory must supply bottles of sufficient volume to perform the required analysis. In most cases, the methodology dictates the volume of sample material required to complete the analysis. However, individual laboratories may provide larger volume containers for various analytes to ensure sufficient quantities for duplicates or other QC checks.

To facilitate transfer of the sample from the sampler into the container and to minimize spillage and sample disturbance, wide-mouth containers are recommended. Aqueous volatile organic samples must be placed into 40-milliliter (ml) glass vials with polytetrafluoroethylene (PTFE) (e.g., TeflonTM) septums. Non-aqueous volatile organic samples should be collected in the same type of vials or in 4-ounce (oz) wide-mouth jars provided by the laboratory. These jars should have PTFE-lined screw caps.

c. Color of Container

Whenever possible, amber glass containers should be used to prevent photodegradation of the sample, except when samples are being collected for metals analysis. If amber containers are not available, then containers holding samples should be protected from light (i.e., place in cooler with ice immediately after filling).

d. Container Closures

Container closures must screw on and off the containers and form a leak-proof seal. Container caps must not be removed until the container is ready to be filled with the sample, and the container cap must be replaced (securely) immediately after filling it. Closures should be constructed of a material which is inert with respect to the sampled material, such as PTFE (e.g., TeflonTM). Alternately, the closure may be separated from the sample by a closure liner that is inert to the sample material such as PTFE sheeting. If soil or sediment samples are being collected, the threads of the container must be wiped clean with a dedicated paper towel or cloth so the cap can be threaded properly.

e. Decontamination of Sample Containers

Sample containers must be laboratory cleaned by the laboratory performing the analysis. The cleaning procedure is dictated by the specific analysis to be performed on the sample. Sample containers must be carefully examined to ensure that all containers appear clean. Do not mistake the preservative as unwanted residue. The bottles should not be field cleaned. If there is any question regarding the integrity of the bottle, then the laboratory must be contacted immediately and the bottle(s) replaced.

f. Sample Bottle Storage and Transport

No matter where the sample bottles are, whether at the laboratory waiting to be packed for shipment or in the field waiting to be filled with sample, care must be taken to avoid contamination. Sample shuttles or coolers, and sample bottles must be stored and transported in clean environments. Sample bottles and clean sampling equipment must never be stored near solvents, gasoline, or other equipment that is a potential source of cross-contamination. When under chain of custody, sample bottles must be secured in locked vehicles, and custody sealed in shuttles or in the presence of authorized personnel. Information which documents that proper storage and transport procedures have been followed must be included in the field notebook and on appropriate field forms.

2.2 Decontamination of Sampling Equipment

Proper decontamination of all re-usable sampling equipment is critical for all sampling episodes. The SOP for Decontamination of Field Equipment and SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for decontamination of various types of equipment.

2.3 Quality Assurance/Quality Control Samples

QA/QC samples are intended to provide control over the proper collection and tracking of environmental measurements, and subsequent review, interpretation and validation of generated analytical data. The SOPs for Collection of Quality Control Samples, for Evaluation and Validation of Data, and for Field Record Keeping and Quality Assurance/Quality Control must be referred to for detailed guidance regarding these respective procedures. SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for QA/QC procedures.

2.4 Sample Preservation Requirements

Certain analytical methodologies for specific analytes require chemical additives in order to stabilize and maintain sample integrity. Generally, this is accomplished under the following two scenarios:

a. Sample bottles are preserved at the laboratory prior to shipment into the field.

b. Preservatives are added in the field immediately after the samples are collected.

Many laboratories provide pre-preserved bottles as a matter of convenience and to help ensure that samples will be preserved immediately upon collection. A problem associated with this method arises if not enough sample could be collected, resulting in too much preservative in the sample. More commonly encountered problems with this method include the possibility of insufficient preservative provided to achieve the desired pH level or the need for additional preservation due to chemical reactions caused by the addition of sample liquids to pre-preserved bottles. The use of pre-preserved bottles is acceptable; however, field sampling teams must always be prepared to add additional preservatives to samples if the aforementioned situations occur. Furthermore, care must be exercised not to overfill sample bottles containing preservatives to prevent the sample and preservative from spilling and therefore diluting the preservative (i.e., not having enough preservative for the volume of sample).

When samples are preserved after collection, special care must be taken. The transportation and handling of concentrated acids in the field requires additional preparation and adherence to appropriate preservation procedures. All preservation acids used in the field should be trace-metal or higher-grade.

2.5 Sample Handling

After the proper sample bottles have been received under chain-of-custody, properly decontaminated equipment has been used to collect the sample, and appropriate preservatives have been added to maintain sample integrity, the final step for the field personnel is checking the sample bottles prior to proper packing and delivery of the samples to the laboratory.

All samples should be organized and the labels checked for accuracy. The caps should be checked for tightness and any 40-ml volatile organic compound (VOC) bottles must be checked for bubbles. Each sample bottle must be placed in an individual "zip-lock" bag to protect the label, and placed on ice. The bottles must be carefully packed to prevent breakage during transport. When several bottles have been collected for an individual sample, they should not be placed adjacent to each other in the cooler to prevent possible breakage of all bottles for a given sample. If there are any samples which are known or suspected to be highly contaminated, these should be placed in an individual cooler under separate chain-of-custody to prevent possible cross contamination. Sufficient ice (wet or blue packs) should be placed in the cooler to maintain the temperature at 4 degrees Celsius (°C) until delivery at the laboratory. Consult the work plan to determine if a particular ice is specified as the preservation for transportation (e.g., the United States Environmental Protection Agency does not like the use of blue packs because they claim that the samples will not hold at 4°C). Blue ice packs will not be used to transport samples being analyzed for Per- and Polyfluoroalkyl Substances (PFAS). If additional coolers are required, then they should be purchased. The chain-of-custody form should be properly completed, placed in a "zip-lock" bag, and placed in the cooler. One copy must be maintained for the project files. The cooler should be sealed with packing tape and a custody seal. The custody seal number should be noted in the field book. Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time. If overnight mail is utilized, then the shipping bill must be maintained for the files and the laboratory must be called the following day to confirm receipt.

3.0 EQUIPMENT AND MATERIALS

3.1 General equipment and materials may include, but not necessarily be limited to, the following:

a. Sample bottles of proper size and type with labels.

b. Cooler with ice (wet or blue pack; no blue packs for PFAS samples).

c. Field notebook, appropriate field form(s), chain-of-custody form(s), custody seals.

d. Black pen and indelible marker.

e. Packing tape, "bubble wrap," and "zip-lock" bags.

f. Overnight (express) mail forms and laboratory address.

g. Health and safety plan (HASP).

h. Work plan/scope of work.

i. Pertinent SOPs for specified tasks and their respective equipment and materials.

3.2 Preservatives for specific samples/analytes as specified by the laboratory. Preservatives must be stored in secure, spillproof glass containers with their content, concentration, and date of preparation and expiration clearly labeled.

3.3 Miscellaneous equipment and materials including, but not necessarily limited to, the following:

a. Graduated pipettes.

b. Pipette bulbs.

c. Litmus paper.

d. Glass stirring rods.

e. Protective goggles.

f. Disposable gloves.

g. Lab apron.

h. First aid kit.

i. Portable eye wash station.

j. Water supply for immediate flushing of spillage, if appropriate.

k. Shovel and container for immediate containerization of spillage-impacted soils, if appropriate.

4.0 PROCEDURE

4.1 Examine all bottles and verify that they are clean and of the proper type, number, and volume for the sampling to be conducted.

4.2 Label bottles carefully and clearly with project name and number, site location, sample identification, date, time, and the sampler's initials using an indelible marker.

4.3 Collect samples in the proper manner (refer to specific sampling SOPs).

4.4 Conduct preservation activities as required after each sample has been collected. Field preservation must be done immediately and must not be done later than 30 minutes after sample collection.

4.5 Conduct QC sampling, as required.

4.6 Seal each container carefully and place in an individual "zip lock" bag.

4.7 Organize and carefully pack all samples in the cooler immediately after collection (e.g., bubble wrap). Insulate samples so that breakage will not occur.

4.8 Complete and place the chain-of-custody form in the cooler after all samples have been collected. Maintain one copy for the project file. If the cooler is to be transferred several times prior to shipment or delivery to the laboratory, it may be easier to tape the chain-of-custody to the exterior of the sealed cooler. When exceptionally hazardous samples are known or suspected to be present, this should be identified on the chain-of-custody as a courtesy to the laboratory personnel.

4.9 Add additional ice as necessary to ensure that it will last until receipt by the laboratory.

4.10 Seal the cooler with packing tape and a custody seal. Record the number of the custody seal in the field notebook and on the field form. If there are any exceptionally hazardous samples, then shipping regulations should be examined to ensure that the sample containers and coolers are in compliance and properly labeled.

4.11 Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

4.12 Maintain the shipping bill for the project files if overnight mail is utilized and call the laboratory the following day to confirm receipt.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for the sampling of ground-water monitoring wells for dissolved constituents. As part of the SOP for the sampling of ground-water monitoring wells, sample collection equipment and devices must be considered, and equipment decontamination and pre-sampling procedures (e.g., measuring water levels, sounding wells, and purging wells) must be implemented. Sampling objectives must be firmly established in the work plan before considering the above.

Valid water-chemistry data are integral to a hydrogeologic investigation that characterizes ground-water quality conditions. Water-quality data are used to evaluate both current and historic aquifer chemistry conditions, as well as to estimate future conditions (e.g., trends, migration pathways). Water-quality data can be used to construct ground-water quality maps to illustrate chemical conditions within the flow system, to generate water-quality plots to depict conditions with time and trends, and to perform statistical analyses to quantify data variability, trends, and cleanup levels.

2.0 EQUIPMENT AND MATERIALS

2.1 In order to sample ground water from monitoring wells, specific equipment and materials are required. The equipment and materials list may include, but not necessarily be limited to, the following:

a. Bailers (Teflon™ or stainless steel).

b. Pumps (centrifugal, peristaltic, bladder, electric submersible, bilge, hand-operated diaphragm, etc.).

c. Gas-displacement device(s).

d. Air-lift device(s).

e. Teflon™ tape, electrical tape.

f. Appropriate discharge hose.

g. Appropriate discharge tubing (e.g., polypropylene, teflon, etc.) if using a peristaltic pump.

h. Appropriate compressed gas if using bladder-type or gas-displacement device.

i. Portable generator and gasoline or alternate power supply if using an electric submersible pump.

j. Non-absorbent cord (e.g., polypropylene, etc.).

k. Plastic sheeting.

l. Tape measure (stainless steel, steel, fiberglass) with 0.01-foot measurement increments and chalk (blue carpenter's).

m. Electronic water-level indicators (e.g., m-scope, etc.) or electric water-level/product level indicators.

n. Non-phosphate, laboratory-grade detergent.

o. Distilled/Deionized water.

p. Potable water.

q. Paper towels, clean rags.

r. Roux Associates' field forms (e.g., daily log, well inspection checklist, sampling, etc.) and field notebook.

s. Well location and site map.

t. Well keys.

u. Stop watch, digital watch with second increments, or watch with a second hand.

v. Water Well Handbook.

w. Calculator.

x. Black pen and water-proof marker.

y. Tools (e.g., pipe wrenches, screwdrivers, hammer, pliers, flashlight, pen knife, etc.).

z. Appropriate health and safety equipment, as specified in the site health and safety plan (HASP).

aa. pH meter(s) and buffers.

bb. Conductivity meter(s) and standards.

cc. Thermometer(s).

dd. Extra batteries (meters, thermometers, flashlight).

ee. Filtration apparatus, filters, pre-filters.

ff. Plasticware (e.g., premeasured buckets, beakers, flasks, funnels).

gg. Disposable gloves.

hh. Water jugs.

ii. Laboratory-supplied sample containers with labels.

jj. Cooler(s).

kk. Ice (wet, blue packs).

ll. Masking, duct, and packing tape.

mm. Chain-of-custody form(s) and custody seal(s).

nn. Site sampling and analysis plan (SAP).

oo. Site health and safety plan (HASP).

pp. Packing material (e.g., bubble wrap)

qq. "Zip-lock" plastic bags.

rr. Overnight (express) mail forms.

3.0 DECONTAMINATION

3.1 Make sure all equipment is decontaminated and cleaned before use (refer to the SOP for Decontamination of Field Equipment for detailed decontamination methods, summaries for bailers and pumps are provided below). Use new, clean materials when decontamination is not appropriate (e.g., non-absorbent cord, disposable gloves). Document, and initial and date the decontamination procedures on the appropriate field form and in the field notebook.

a. Decontaminate a bailer by: 1) wearing disposable gloves, 2) disassembling (if appropriate) and scrubbing in a non-phosphate, laboratory-grade detergent and distilled/deionized water solution, and 3) rinsing first with potable water and then distilled/deionized water.

b. Decontaminate a pump by: 1) wearing disposable gloves, 2) flushing the pump and discharge hose (if not disposable) first with a non-phosphate, laboratory-grade detergent and potable water solution in an appropriate container (clean bucket, garbage can, or 55-gallon drum) and then with distilled/deionized water or potable water, and 3) wiping pump-related equipment (e.g., electrical lines, cables, discharge hose) first with a clean cloth and detergent solution and then rinsing or wiping with a clean cloth and distilled/deionized water or potable water.

3.2 Note that the decontamination procedures for bailers and pumps are the minimum that must be performed. Check the work plan to determine if chemicals specified by individual state regulatory agencies must also be used for decontamination procedures (e.g., hexane, nitric acid, acetone, isopropanol, etc.).

4.0 CALIBRATION OF FIELD ANALYSIS EQUIPMENT

Calibrate field analysis equipment before use (e.g., thermometers, pH and conductivity meters, etc.). Refer to the specific SOP for field analysis for each respective piece of equipment. Document, and initial and date the calibration procedures on the appropriate field form, in the field notebook, and in the calibration log book.

5.0 PROCEDURE

5.1 Document, and initial and date well identification, pre-sampling information, and problems encountered on the appropriate field form and in the field notebook as needed.

5.2 Inspect the protective casing of the well and the well casing, and note any items of concern such as a missing lock, or bent or damaged casing(s).

5.3 Place plastic sheeting around the well to protect sampling equipment from potential cross contamination.

5.4 Remove the well cap or plug and, if necessary, clean the top of the well off with a clean rag. Place the cap or plug on the plastic sheeting. If the well is not vented, allow several minutes for the water level in the well to equilibrate. If fumes or gases are present, then diagnose these with the proper safety equipment. Never inhale the vapors.

5.5 Measure the depth to water (DTW) from the measuring point (MP) on the well using a steel tape and chalk or an electronic sounding device (m-scope). Refer to the specific SOPs for details regarding the use of a steel tape or a m-scope for measuring water levels. Calculate the water-level elevation. Document, and initial and date the information on the appropriate field form and in the field notebook.

5.6 Measuring the total depth of the well from the MP with a weighted steel tape. Calculate and record the volume of standing water in the well casing on the appropriate field form and in the field notebook.

5.7 Decontaminate the equipment used to measure the water level and sound the well with a non-phosphate, laboratory-grade detergent solution followed by a distilled/deionized water rinse.

5.8 Purge the well prior to sampling (refer to the SOP for Purging a Well). The well should be pumped or bailed to remove the volume of water specified in the work plan. Usually three to five casing volumes are removed if the recharge rate is adequate to accomplish this within a reasonable amount of time.

If the formation cannot produce enough water to sustain purging, then one of two options must be followed. These include: 1) pumping or bailing the well dry, or 2) pumping or bailing the well to "near-dry" conditions (i.e., leaving some water in the well). The option employed must be specified in the work plan and be in accordance with regulatory requirements.

If the well is purged dry, then all the standing water has been removed and upon recovery the well is ready for sampling. However, depending on the rate of recovery and the time needed to complete the sampling round, one of the following procedures may have to be implemented: 1) the well may have to be sampled over a period of more than one day; 2) the well may not yield enough water to collect a complete suite of samples and only select (most important) samples will be collected; or 3) the well may not recover which will preclude sampling. Regardless of the option that must be followed, the sampling procedure must be fully documented. When preparing to conduct a sampling round, review drilling, development and previous sampling information (if available) to identify low-yielding wells in order to purge them first, and potentially allow time for the well to recover for sampling.

5.9 Record the physical appearance of the water (i.e., color, turbidity, odor, etc.) on the appropriate field form and in the field notebook, as it is purged. Note any changes that occur during purging.

5.10 If a bailer is used to collect the sample, then:

a. Flush the decontaminated bailer three times with distilled/deionized water.

b. Tie the non-absorbent cord (polypropylene) to the bailer with a secure knot and then tie the free end of the bailer cord to the protective casing or, if possible, some nearby structure to prevent losing the bailer and cord down the well.

c. Lower the bailer slowly down the well and into the water column to minimize disturbance of the water surface. If a bottom-filling bailer is used, then do not submerge the top of the bailer; however, if a top-filling bailer is used, then submerge the bailer several feet below the water surface.

d. Remove and properly discard one bailer volume from the well to rinse the bailer with well water before sampling. Again, lower the bailer slowly down the well to the appropriate depth depending on the bailer type (as discussed above in 5.11 c). When removing the bailer from the well, do not allow the bailer cord to rest on the ground but coil it on the protective plastic sheeting placed around the well. Certain regulatory agencies require that the first bailer volume collected be utilized for the samples.

5.11 If a pump is used to collect the sample, then use the same pump used to purge the well and, if need be, reduce the discharge rate to facilitate filling sample containers and to avoid problems that can occur while filling sample containers (as listed in Number 5.14, below). Alternately, the purge pump may be removed and a thoroughly decontaminated bailer can be used to collect the sample.

5.12 Remove each appropriate container's cap only when ready to fill each with the water sample, and then replace and secure the cap immediately.

5.13 Fill each appropriate, pre-labeled sample container carefully and cautiously to prevent: 1) agitating or creating turbulence; 2) breaking the container; 3) entry of, or contact with, any other medium; and 4) spilling/splashing the sample and exposing the sampling team to contaminated water. Immediately place the filled sample container in a ice-filled (wet ice or blue pack) cooler for storage. If wet ice is used it is recommended that it be repackaged in zip-lock bags to help keep the cooler dry and the sample labels secure. Check the work plan as to whether wet ice or blue packs are specified for cooling the samples because certain regulatory agencies may specify the use of one and not the other.

5.14 "Top-off" containers for volatile organic compounds (VOCs) and tightly seal with Teflon™-lined septums held in place by open-top screw caps to prevent volatilization. Ensure that there are no bubbles by turning the container upside down and tapping it gently.

5.15 Filter water samples (Procedure 4.6) collected for dissolved metals analysis prior to preservation to remove the suspended sediment from the sample. If water samples are to be collected for total metals analysis, then collect a second set of samples without field filtering.

In the event that the regulatory agency(ies) want unfiltered samples for metals analysis, a second set of filtered samples should also be collected. Because unfiltered samples are indications of total metals (dissolved and suspended) they are not representative of aquifer conditions because ground water does not transport sediment (except in some rare cases). Thus, the results for dissolved metals in ground water should be based on filtered samples even if both filtered and unfiltered sets are presented in a report.

5.16 Add any necessary preservative(s) to the appropriate container(s) prior to, or after (preferred), the collection of the sample, unless the appropriate preservative(s) have already been added by the laboratory before shipment.

5.17 Collect quality control (QC) samples as required in the work plan to monitor sampling and laboratory performance. Refer to the SOP for Collection of Quality Control Samples.

5.18 Conduct field analyses after sample collection is complete by measuring and recording the temperature, conductivity, pH, etc. (as called for in the work plan). Note and record the "final" physical appearance of the water (after purging and sampling) on an appropriate field form and in the field notebook.

5.19 Wipe the well cap with a clean rag, replace the well cap and protective cover (if present). Lock the protective cover.

5.20 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," placed in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory.

5.21 Decontaminate bailers, hoses, and pumps as discussed in the decontamination SOP. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard cords, rags, gloves, etc. in a manner consistent with site conditions.

5.22 Complete all necessary field forms, field notebook entries, and the chain-of-custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

5.23 Samples collected from Monday through Friday will be delivered within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Consult the work plan to determine if any of the analytes require a shorter delivery time.

END OF PROCUDURE

ATTACHMENT 4

NYSDEC PFAS Sampling Guidance

NEW YORK STATE OF OPPORTUNITY

Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

April 2023

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April 2023

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Data Assessment and Application to Site Cleanup Page 3	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published	3/28/2023
Water Sample Results Page 3	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below.	NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These guidance values also include criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt).Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.	3/28/2023
Soil Sample Results Page 3	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values:	NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:	3/28/2023
Protection of Groundwater Page 3	PFOA (ppb) 1.1 PFOS (ppb) 3.7	PFOA (ppb) 0.8 PFOS (ppb) 1.0	3/28/2023

Citation and Page Number	Current Text	Corrected Text	Date
Footnote 2 Page 3	The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	3/28/2023
Testing for Imported Soil Page 4	If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.	If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.	3/28/2023
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Soil Sample Results, page 10	"The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase."	"Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. " [Interim SCO Table] "PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. "	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021
Water Sample Results Page 9	"In addition, further assessment of water may be warranted if either of the following screening levels are met: a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L"	Deleted	6/15/2021

Citation and Page Number	Current Text	Corrected Text	Date
Routine Analysis, Page XX	Currently, New York State Department of Health's Environmental Laboratory Approval Program (ELAP)… criteria set forth in the DER's laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids).	Deleted	5/31/2022
Analysis and Reporting, Page XX	As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.	Deleted	5/31/2022
Routine Analysis, Page XX	LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media.	EPA Method 1633 is the procedure to use for environmental samples.	
Soil Sample Results, Page XX	Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6	Soil cleanup objectives for PFOA and PFOS have been proposed in an upcoming revision to 6 NYCRR Part 375-6	
Appendix A	"Include in the text… LC-MS/MS for PFAS using methodologies based on EPA Method 537.1"	"Include in the text ….EPA Method 1633"	
Appendix A	"Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101"	Deleted	
Appendix B	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	

Citation and Page Number	Current Text	Corrected Text	Date
Appendix C	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix D	"Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1"	"Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633"	
Appendix G		Updated to include all forty PFAS analytes in EPA Method 533	
Appendix H		Deleted	
Appendix I	Appendix I	Appendix H	
Appendix H	"These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report."	"These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER)."	
Appendix H	"The holding time is 14 days…"	"The holding time is 28 days…"	
Appendix H, Initial Calibration	"The initial calibration should contain a minimum of five standards for linear fit…"	"The initial calibration should contain a minimum of six standards for linear fit…"	
Appendix H, Initial Calibration	Linear fit calibration curves should have an R^2 value greater than 0.990.	Deleted	
Appendix H, Initial Calibration Verification	Initial Calibration Verification Section	Deleted	
Appendix H	secondary Ion Monitoring Section	Deleted	
Appendix H	Branched and Linear Isomers Section	Deleted	

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

April 2023

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

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Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments, or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third-party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix G) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

EPA Method 1633 is the procedure to use for environmental samples. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist. Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

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[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

NYSDEC has adopted ambient water quality guidance values for PFOA and PFOS. Groundwater samples should be compared to the human health criteria of 6.7 ng/l (ppt) for PFOA and 2.7 ng/l (ppt) for PFOS. These human health criteria should also be applied to surface water that is used as a water supply. This guidance also includes criteria for surface water for PFOS applicable for aquatic life, which may be applicable at some sites. Drinking water sample results should be compared to the NYS maximum contaminant level (MCL) of 10 ng/l (ppt). Analysis to determine if PFOA and PFOS concentrations are attributable to the site should include a comparison between upgradient and downgradient levels, and the presence of soil source areas, as defined below.

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

NYSDEC will delay adding soil cleanup objectives for PFOA and PFOS to 6 NYCRR Part 375-6 until the PFAS rural soil background study has been completed. Until SCOs are in effect, the following are to be used as guidance values:

Guidance Values for Anticipated Site Use	**PFOA (ppb)**	**PFOS (ppb)**
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	0.8	1.0

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These

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[2] The Protection of Groundwater values are based on the above referenced ambient groundwater guidance values. Details on that calculation are available in the following document, prepared for the February 2022 proposed changes to Part 375 (https://www.dec.ny.gov/docs/remediation_hudson_pdf/part375techsupport.pdf). The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above the ambient water quality guidance values for groundwater, then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an "Analytical Methods/Quality Assurance Summary Table" specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by EPA Method 1633
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
-
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using EPA Method 1633.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled "General Fish Handling Procedures for Contaminant Analysis" (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonic acids	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
Perfluoroalkyl carboxylic acids	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	PFTeDA	376-06-7
Per- and Polyfluoroether carboxylic acids	Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
	4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4
	Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
	Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
	Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6
Fluorotelomer sulfonic acids	4:2 Fluorotelomer sulfonic acid	4:2-FTS	757124-72-4
	6:2 Fluorotelomer sulfonic acid	6:2-FTS	27619-97-2
	8:2 Fluorotelomer sulfonic acid	8:2-FTS	39108-34-4
Fluorotelomer carboxylic acids	3:3 Fluorotelomer carboxylic acid	3:3 FTCA	356-02-5
	5:3 Fluorotelomer carboxylic acid	5:3 FTCA	914637-49-3
	7:3 Fluorotelomer carboxylic acid	7:3 FTCA	812-70-4
Perfluorooctane sulfonamides	Perfluorooctane sulfonamide	PFOSA	754-91-6
	N-methylperfluorooctane sulfonamide	NMeFOSA	31506-32-8
	N-ethylperfluorooctane sulfonamide	NEtFOSA	4151-50-2
Perfluorooctane sulfonamidoacetic acids	N-methylperfluorooctane sulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethylperfluorooctane sulfonamidoacetic acid	N-EtFOSAA	2991-50-6
Perfluorooctane sulfonamide ethanols	N-methylperfluorooctane sulfonamidoethanol	MeFOSE	24448-09-7
	N-ethylperfluorooctane sulfonamidoethanol	EtFOSE	1691-99-2

Group	Chemical Name	Abbreviation	CAS Number
Ether sulfonic acids	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUdS	763051-92-9
	Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA	113507-82-7

Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS using EPA Method 1633 for projects within the Division of Environmental Remediation (DER). Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 28 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of six standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

Remedial Investigation Work Plan
Diagravure Film Manufacturing Site
268 Bergen Street, 287 Wyckoff Street and
N/A Wyckoff Street, Brooklyn, New York
NYSDEC Project Number C224403

APPENDIX D

Site-Specific Health and Safety Plan

ROUX

Site-Specific Health & Safety Plan

Diagravure Film Manufacturing Site
NYSDEC Project Number C224403
268 Bergen Street,
287 Wyckoff Street, and
N/A Wyckoff Street
Brooklyn, New York

June 7, 2024

Prepared for:

Bergen St. Equity LLC
505 Flushing Avenue #1H
Brooklyn, New York 11205

Prepared by:

Roux Environmental Engineering and Geology, D.P.C.
209 Shafter Street
Islandia, New York 11749

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& Management
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Site-Specific Emergency Information

Emergency Phone Numbers

Most emergency services can be obtained by calling **911**. Where 911 service is not available, use the telephone numbers provided in the below table. The following is a master emergency phone list for use by the project management personnel. A more condensed version of the emergency numbers listed below will be posted throughout project work areas. Emergencies encountered on the site will be responded to by a combination of off-site emergency services and on-site personnel.

Emergency Contact Information			
Site Personnel			
Title	**Contact**		**Telephone**
Operations Manager (OM)	Jeff Wills		516-637-0213
Project Principal (PP)	Robert Kovacs		516-250-0359
Project Manager (PM)	Julia Michaels		631-626-8831
Site Supervisor (SS)	To Be Determined		347-425-3769
Site Health and Site Safety Officer (SHSO)	To Be Determined		347-425-3769
Office Health and Safety Manager (OHSM)	Nevin Pahlad		347-885-6930
Corporate Health and Safety Director (CHSD)	Brian Hobbs, CIH, CSP		631-807-0193
WorkCare, Inc. (Formally AllOne Health)	Occupational Health Care Management Provider		800-350-4511
Client Emergency Contact			
Outside Assistance			
Agency	**Contact**	**Telephone**	**Address/Location**
Ambulance/emergency medical services (EMS)	FDNY EMS Station 32	718-222-1290	347 Bond Street, Brooklyn, NY 11231
Police	NYPD 78th Precinct	**718-636-6411**	65 6th Avenue, Brooklyn, NY 11217
Fire	FDNY Engine 226	718-965-8226	409 State Street, Brooklyn, NY 11217
Site Address	268 Bergen Street, 287 Wyckoff Street and N/A Wyckoff Street, Brooklyn, NY 11217		

New York Presbyterian Brooklyn Methodist Hospital – 506 6th Street, Brooklyn, NY 11215

- Head southwest toward 3rd Ave
- Turn right onto 3rd Ave
- Turn left onto 3rd St.
- Turn right onto 6th Ave
- Turn left onto 7th Ave

- Turn left onto 8th Ave
- Turn left at the 1st cross street onto 6th St. New York-Presbyterian Brooklyn Methodist Hospital will be on the left.

Northwell-Health GoHealth Urgent Care

- Head southeast toward 3rd Ave
- Turn right onto 3rd Ave
- Turn left onto St Marks Place
- Turn left onto 6th Ave
- Turn right onto Flatbush Ave. Urgent Care will be on the left.

FDNY EMS Station 32

- Head southeast toward 3rd Ave
- Turn right onto 3rd Ave
- Turn right onto 3rd St
- Turn right onto Bond St. FDNY EMS Station 32 will be on the right.

1. Introduction

This Site-specific Health and Safety Plan (HASP) has been prepared by Roux Environmental Engineering and Geology, D.P.C. (Roux) for use during the Remedial Investigation (RI) sampling at the Diagravure Film Manufacturing Site, located at 268 Bergen Street, 287 Wyckoff Street and N/A Wyckoff Street, Brooklyn, New York (Site) (Site; **Figure 1**). This HASP was prepared in general accordance with the requirements of the Occupational Safety and Health Administration (OSHA) standards promulgated at 29 CFR 1910.120 and 29 CFR 1926.65, both commonly referred to as the Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard. In accordance with the HAZWOPER Standard, this Site-specific HASP was prepared to address the safety and health hazards associated with the RI sampling activities being performed at the Site by Roux and to provide requirements and procedures for the protection of Roux employees, subcontractor personnel, government oversight personnel, Site personnel, and the general public. It also addresses client- and Site-specific requirements for health and safety. Additionally, subcontractors may be required to submit their own HASP as it relates to their specific work activities and will be kept onsite during such work.

Implementation of this HASP is the joint responsibility of the Project Manager (PM), the Site Health and Safety Officer (SHSO), and all field staff, with assistance from the Project Principal (PP), Office Health and Safety Manager (OHSM), and Corporate Health and Safety Director (CHSD). The PM for this project is Julia Michaels. The Site Supervisor (SS)/Safety Officer (SHSO) will be determined prior to the start of work.

This HASP will be introduced to, reviewed, and signed off on by all Roux personnel through a formal training session prior to commencing work. A copy of the HASP will be kept at the Site at all times. The Roux SHSO or PM will be responsible for posting any changes, amendments, memos, etc. to the HASP. Any revisions to this HASP will be signed by appropriate personnel, which can include Roux's PP, CHSD, and SS. Any changes will be announced to all workers at the next safety meeting.

1.1 Roles and Responsibilities

Overall Roles and Responsibilities (R&Rs) of Roux personnel are provided in Roux's Policies and Procedures Manual. Only those R&Rs specific to HASP requirements are listed below. Professional Profiles for Roux personnel noting OSHA certifications are included in **Appendix A.**

Project Manager (PM)

The PM has responsibility and authority to direct all work operations. The PM coordinates safety and health functions with the Site Health and Safety Officer (SHSO), has the authority to oversee and monitor the performance of the SHSO, and bears ultimate responsibility for the proper implementation of this HASP. The specific duties of the PM are:

- Preparing and coordinating the Site work plan;
- Providing Site supervisor(s) with work assignments and overseeing their performance; Coordinating safety and health efforts with the SSHO;
- Ensuring effective emergency response through coordination with the Emergency Response Coordinator (ERC); and
- Serving as primary Site liaison with public agencies and officials and Site contractors.

Site Health and Safety Officer (SHSO)

The SHSO has the full responsibility and authority to develop and implement this HASP and to verify compliance. The SHSO reports to the Project Manager. The SHSO is on Site or readily accessible to the Site during all work operations and has the authority to halt Site work if unsafe conditions are detected. The specific responsibilities of the SHSO include:

- Managing the safety and health functions on this Site;
- Serving as the Site's point of contact for safety and health matters;
- Ensuring Site monitoring, worker training, and effective selection and use of PPE;
- Assessing Site conditions for unsafe acts and conditions and providing corrective action;
- Assisting the preparation and review of this HASP;
- Maintaining effective safety and health records as described in this HASP; and
- Coordinating with the SS and others as necessary for safety and health efforts.

Site Supervisor (SS)

The Site Supervisor (SS) is responsible for field operations and reports to the Project Manager (PM). The SS ensures the implementation of the HASP requirements and procedures in the field. The specific responsibilities of the Site Supervisor include:

- Executing the work plan and schedule as detailed by the PM;
- Coordination with the SHSO on safety and health; and
- Ensuring Site work compliance with the requirements of this HASP.

Employees

All Roux employees are responsible for reading and following all provisions of the Corporate Health and Safety Manual, including this HASP. Employees report to the SS at the project Site. Each employee is also responsible for the following:

- Wearing all appropriate PPE as outlined within this HASP;
- Attending all safety meetings;
- Inspecting tools and equipment prior to use, and taking any defective tools or equipment out of service;
- Appropriately documenting field events as they occur within a logbook or equivalent;
- Properly operating machinery and/or equipment only if trained to do so;
- Stopping work operations if unsafe conditions exist;
- Identifying and mitigating hazards when observed;
- Reporting all incidents and near misses to the Roux SHSO and SS immediately; and
- Knowing where emergency equipment is located (e.g. first aid kit, fire extinguisher).

Subcontractors and Visitors

Subcontractors and visitors are responsible for complying with the same health and safety requirements. It is the responsibility of all to make sure subcontractors and visitors comply and uphold the HASP. Subcontractors and visitors have the following additional responsibilities:

- Designating a qualified safety representative for the project that can make the necessary changes in work practices, as necessary;
- Attending all safety meetings while participating in Roux Site work activities;
- Reporting all incidents and near misses to Roux SHSO and SS immediately;
- Conducting initial and periodic equipment inspections in accordance with manufacturer and regulatory guidelines; and
- Providing copies of all Safety Data Sheets (SDS) to Roux SHSO for materials brought to the Site.

2. Background

Relevant background information is provided below, including a general description of the Site; a brief review of the Site's history with respect to hazardous material use, handling, and/or storage; and a review of known and potential releases of hazardous substances at the Site.

2.1 Site Description

The Site is identified three irregularly shaped lots which total 1.19 acres between Bergen Street and Wyckoff Street in Brooklyn, located within the City and State of New York. The Site is further identified by the following block, lot, and address according to the NYCDOB:

- Block 388, Lot 19: 268 – 298 Bergen Street, Brooklyn, NY;
- Block 388, Lot 42: 287 Wyckoff Street; and
- Block 388, Lot 51: 273 Wyckoff Street.

2.2 Site History

A review of historical sources, including historical Sanborn Fire Insurance maps, historical aerial photographs, historical topographic maps, and a City Directory Abstract, as well as an interview with a Key Site Representative, indicate that the Site was first developed prior to 1886 with multiple residences and a hand lumber facility. By 1904, the lumber facility was replaced by a facility operated by the Federal Brewing Company. By 1915, the Federal Brewing Company was replaced by the R.F. Stevens Milk Company as a milk distribution depot. By 1938, the depot was used as a private automobile parking facility.

3. Scope of Work

The scope of work (SOW) associated with the RI includes the following activities:

- The performance of Site reconnaissance to confirm/supplement proposed sampling locations;
- The advancement of soil borings, collection of soil samples, installation of groundwater monitoring wells, collection of groundwater samples, installation of soil vapor monitoring points, and collection of soil vapor samples;
- The collection of a synoptic round of groundwater level measurements and the collection of additional land survey data as needed for developing a groundwater elevation contour map;
- Community Air Monitoring Plan (CAMP) implementation

If there are any changes with the scope a revision of the HASP will be required to address any new hazards.

4. Site Control

This Site control program is designed to reduce the spread of hazardous substances from contaminated areas to clean areas, to identify and isolate contaminated areas of the Site, to facilitate emergency evacuation and medical care, to prevent unauthorized entry to the Site, and to deter vandalism and theft.

4.1 Site Map

A map of this Site, showing Site boundaries, designated work zones, and points of entry and exit is provided in **Figure 2**.

4.2 Site Access

Access to the work areas at the Site is restricted to reduce the potential for exposure to its safety and health hazards. During hours of Site operation, Site entry and exit is authorized only at the points identified in **Figure 2**. Entry and exit at these points is controlled by the following: locking doors. When the Site is not operating, access to the Site is controlled by the following: locking doors.

4.3 Buddy System

This section is not applicable for all components of the SOW described in Section 3. Some Site inspections, soil sampling, or groundwater sampling are completed by a single Roux employee. However, when completing these tasks, the single Roux employee is accompanied either by Roux subcontractors or the Site caretaker/other representatives from Lande Alexander Property. Any time Roux is on-site, Developing NY State and Lande Alexander Property is made aware and communications with Developing NY State and Lande Alexander Property and the Roux PM is maintained via cellular phone.

While working in the Exclusion Zone, Site workers use the buddy system. The buddy system means that personnel work in pairs and stay in close visual contact to be able to observe one another and summon rapid assistance in case of an emergency. The responsibilities of workers using the buddy system include:

- Remaining in close visual contact with partner;
- Providing partner with assistance as needed or requested;
- Observing partner for signs of heat stress, chemical overexposure or other difficulties;
- Periodically checking the integrity of partner's PPE; and
- Notifying the SS or other Site personnel if emergency assistance is needed.

4.4 Site Communications

The following communication equipment is used to support on-site communication: cell phones, visual hand signals.

As applicable, hand signals will be used according to the following:

Hand Signals

SIGNAL	MEANING
Hand gripping throat	Out of air, can't breathe
Grip partner's wrist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	I'm all right, okay
Thumbs down	No, negative

A current list of emergency contact numbers is included in the Site-Specific Emergency Information at the beginning of this HASP.

4.5 Site Work Zones

This Site is divided into three (3) major zones, described below. These zones are characterized by the likely presence or absence of biological, chemical, or physical hazards and the activities performed within them. Zone boundaries are clearly marked at all times and the flow of personnel among the zones is controlled. The Site is monitored for changing conditions that may warrant adjustment of zone boundaries. Zone boundaries are adjusted as necessary to protect personnel and clean areas. Whenever boundaries are adjusted, zone markings are also changed and workers are immediately notified of the change.

Exclusion Zone

The area where contamination exists is the Exclusion Zone (EZ). All areas where excavation and handling of contaminated materials take place are considered part of the EZ. This zone will be clearly delineated by chain link fencing, caution tape, cones or other effective barriers, as necessary. Safety tape may be used as a secondary delineation within the EZ. The zone delineation markings may be opened in areas for varying lengths of time to accommodate equipment operation or specific construction activities. The SHSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy (co-worker);
- Required minimum level PPE;
- Medical authorization;
- Training certification; and
- Requirement to be in the zone.

Contamination Reduction Zone

A Contamination Reduction Zone (CRZ) is established between the exclusion zone and the support zone. The CRZ contains the Contamination Reduction Corridor (CRC) and provides an area for decontamination of personnel and equipment. The CRZ will be used for general Site entry and egress in addition to access for heavy equipment and emergency support services. Personnel are not allowed in the CRZ without:

- A buddy (co-worker);
- Appropriate PPE;
- Medical authorization;
- Training certification; and
- Requirement to be in the zone.

Support Zone

The Support Zone (SZ) is an uncontaminated area that will be the field support area for the Site operations. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel or materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples.

5. Job Hazard Evaluation

Roux's work at the Site is expected to entail a variety of physical, chemical, and biological hazards, all of which must be sufficiently managed to allow the work to be performed safely. Some of the hazards are Site-specific (i.e., they are associated with the nature, physical characteristics, and/or routine operation of the Site itself), while others are activity-specific (i.e., they are associated with [or arise from] the particular activity being performed). The various hazards can be grouped into the following categories:

- **Caught/Crushed** – the potential to become caught in, under, between, or by an object or parts of an object, such as equipment with parts that open and close or move up and down ("pinch points") or equipment that rotates, and the accompanying potential to have body parts cut, mangled, or crushed thereby.
- **Contact** – the potential to be struck by or against moving or stationary objects that can cause physical injury, such as heavy machinery, overhead piping, moving vehicles, falling objects, and equipment (including tools and hand-held equipment) or infrastructure with the ability to cut or impale.
- **Energy Sources** – the potential for bodily harm associated with energy sources, most notably electricity, but also including latent energy sources such as compressed air and equipment under tension (which when released could cause injurious contact or a fall).
- **Ergonomics** – the potential for musculoskeletal injury associated with lifting/carrying, pushing/pulling, bending, reaching, and other physical activity attributable to poor body position/mechanics, repetitive motion, and/or vibration.
- **Exposure** – the potential for injury/illness due to physical, chemical, or biological exposures in the work environment, including, but not limited to, temperature extremes, solar radiation, and noise (physical), chemical splashes and hazardous atmospheres (chemical), and animal/insect bites and poisonous plants (biological).
- **Falls** – the potential to slip or trip and thus fall or drop a load, resulting in bodily injury to oneself or others.

The foregoing is intended to provide Roux employees with a general awareness of the hazards involved with Site work. A more detailed review of the potential hazards associated with each specific activity planned for the Site (or on-going activity, as the case may be) is provided in the activity-specific Job Safety Analysis (JSA) forms in **Appendix B**. As can be seen in the JSA forms, the hazards are identified by category per the above, and specific measures designed to mitigate/manage those hazards are also identified. In preparing the JSA forms, all categories of hazards were considered, and all anticipated potential hazards were identified to the extent possible based on the experience of the personnel preparing and reviewing the JSA forms. However, there is always the possibility for an unanticipated hazard to arise, potentially as condition change over the course of the workday. Roux personnel must maintain a continual awareness of potential hazards in the work zone, regardless of whether the hazard is identified in the JSA form. Particular attention should be paid to hazards associated with exposure to hazardous substances (see **Table 1** for a listing of the hazardous substances most likely to be encountered in environmental media at the Site) and to Site personnel being located "in the line of fire" with respect to moving equipment, pinch points, and latent energy (e.g., being located or having body parts located within the swing radius of an excavator, between two sections of pipe being connected, below a piece of suspended equipment, or adjacent to a compressed air line).

5.1 Hazard Communication and Overall Site Information Program

The information in the JSAs and SDSs is made available to all employees and subcontractors who could be affected by it prior to the time they begin their work activities.

Modifications to JSAs are communicated during routine pre-work briefings, and periodically updated as needed in the HASP. SDSs will be maintained by the SHSO/SS for new chemicals brought on-site as needed. Copies of SDSs can be found in **Appendix C**.

5.2 Noise

Noise is associated with the operation of heavy equipment, power tools, pumps, and generators. Noise is also a potential hazard when working near operating equipment such as excavators, drill rigs or pole drivers. High noise (i.e., < 85 dBA) operations may be evaluated by the SHSO utilizing a type 2 handheld sound level meter (SLM) operating on the "A"-weighted scale with slow response because this scale most closely resembles human response to noise and complies with OSHA 29 CFR 1910.95. Hearing protection is required in areas with noise exposure greater than 85 dBA. Double hearing protection (ear plugs and earmuffs) should be donned in areas where the noise exposure is more than 95 dBA. Noise exposure will be controlled by hearing protection as described above or by maintaining set-backs from high-noise equipment, as warranted. Personnel handling heavy equipment and using power tools that produce noise levels exceeding those described levels above are required by OSHA 29 CFR 1910.95 to wear the appropriate Noise Reduction Rating (NRR) level of hearing protection. Appropriate hearing protection will be evaluated by the SHSO as necessary in consultation with the OHSM and CHSD.

5.3 Slip, Trip, and Fall Hazards

Slip, trip, and fall hazards may include, but are not limited to, general slip and trip hazards associated with uneven ground, possible debris, wet grass, and equipment. Prior to work, walking paths will be assessed for solid footings, any ground penetrations that may cause a tripping hazard will be appropriately marked, and other areas will be noted and discussed with the field team.

Personnel shall be aware of their surroundings and footings at all time, and all accommodations should be made for proper housekeeping and organized equipment placement at the Site, where possible, to help prevent any slip, trip, and fall-related incidents. All tools and materials should be appropriately stored when not in use and placed in appropriate storage containers.

5.4 Biological Hazards

Biological hazards that may potentially be present at a Site, include poisonous plants, insects (ticks, spiders, bees), animals (snakes, dogs), etc. Information on biological hazards can be found within Roux's Biological Hazard Awareness Management Program located within Roux's Corporate Health and Safety Manual. There is also potential for transmission and/or exposure to SARS-CoV-2, the virus that causes COVID-19. Prior to beginning work, on-Site protocols shall be established by the project team, including subcontractors, in accordance with federal, state, county, city, and/or other guidance, as applicable and consistent with Roux's COVID-19 Interim Health and Safety Guidance which can be found in **Appendix D**.

6. Emergency Response Plan

This emergency response plan details actions to be taken in the event of Site emergencies. The PM and SHSO is responsible for the implementation of emergency response procedures onsite. The SHSO/PM provides specific direction for emergency action based upon information available regarding the incident and response capabilities and initiates emergency procedures and notification of appropriate authorities. In the event of an emergency, Site personnel are evacuated and do not participate in emergency response activities, response is facilitated through external emergency services.

6.1 Emergency Response

The SHSO, after investigating the incident and relevant information, shall determine the level of response required for containment, rescue and medical care. Limited on-site emergency response activities could occur therefore the SHSO is responsible for notifying external emergency response agencies. The SHSO provides relevant information to the responding organizations, including, but not limited to, the hazards associated with the emergency incident, potential containment problems, and missing Site personnel.

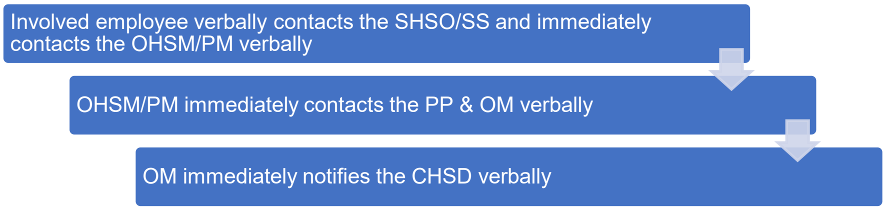
6.2 Emergency Alerting and Evacuation

If evacuation notice is given, Site workers leave the worksite, if possible, by way of the nearest exit. Appropriate primary and alternate evacuation routes and assembly areas have been identified and are shown on the Site Plan with Emergency Muster Area (**Figure 2**). The routes and assembly area will be determined by conditions at the time of the evacuation based on wind direction, the location of the hazard source, and other factors as determined by SHSO/PM.

Personnel exiting the Site gather at a designated assembly point. To determine that everyone has successfully exited the Site, personnel will be accounted for at the assembly point. If any worker cannot be accounted for, notification is given to the SHSO, PM, and any arriving response authorities so that appropriate action can be initiated. Subcontractors on this Site have coordinated their emergency response plans to ensure that these plans are compatible and potential emergencies are recognized, alarm systems are clearly understood, and evacuation routes are accessible to all personnel relying upon them.

6.3 Emergency Medical Treatment and First Aid

In the event of a work-related injury or illness, employees are required to follow the procedures outlined below. All work-place injury and illness situations require Roux's Project and Corporate Management Team to be notified when an injury/illness incident occurs, and communication with the contracted Occupational Health Care Management Provider, WorkCare, Inc. (Formally AllOne Health), is initiated, as necessary. The Injury/Illness Notification Flowchart is provided below and within Roux's Incident Investigation and Reporting program included within Roux's Corporate Health and Safety Manual.



Involved employee verbally contacts the SHSO/SS and immediately contacts the OHSM/PM verbally

OHSM/PM immediately contacts the PP & OM verbally

OM immediately notifies the CHSD verbally

If on-Site personnel require any medical treatment, the following steps will be taken:

a. Notify Roux's Project and Corporate Management Team for any work-related injury and/or illness occurrence, and communicate with the contracted Occupational Health Care Management Provider, WorkCare, immediately following the notifications provided above.

b. Based on discussions with the Project Team, Corporate Management and the WorkCare evaluation, if medical attention beyond onsite first aid is warranted, transport the injured / ill person (IP) to the Urgent Care Center, or notify the Fire Department or Ambulance Emergency service and request an ambulance or transport the victim to the hospital, and continue communications with Corporate Management Team. An Urgent Care/Hospital Route map with location to Northwell Health GoHealth Urgent Care/New York-Presbyterian Brooklyn Hospital is included as **Figure 3**.

c. Decontaminate to the extent possible prior to administration of first aid or movement to medical or emergency facilities.

d. First aid medical support will be provided by onsite personnel trained and certified in First Aid, Cardio Pulmonary Resuscitation (CPR), Automatic External Defibrillation (AED), and Blood-Borne Pathogens (BBP) Awareness, until relieved by emergency medical services (EMS).

e. The SHSO and PM will perform a Loss Investigation (LI) and the Project Team will complete the final Loss Report. If a Roux employee is involved in a vehicular incident, the employee must also complete the Acord Automobile Loss Notice.

7. Environmental Conditions and Response

7.1 Adverse Weather Conditions

In the event of adverse weather conditions, the SHSO or project principal will determine if work can continue without jeopardizing the health and safety of field workers. Some of the items related to adverse weather conditions to be considered prior to determining if work should continue include:

- Potential for heat stress and heat-related injuries;
- Potential for cold stress and cold-related injuries;
- Treacherous weather-related conditions. If wind speed is greater than 15 mph averaged over a 15-minute period or wind gusts over 25 mph, earthmoving operations will be ceased
- Limited visibility; and
- Electrical storm potential.

Site activities will be limited to daylight hours and acceptable weather conditions. Inclement working conditions may include heavy rain, fog, high winds, and lightning. The SHSO and/or PM shall observe daily weather reports and evacuate, if necessary, in case of inclement weather conditions.

7.2 Electrical Storm Guidelines

In the event that lightning and/or thunder are observed while working onsite, all onsite activities shall stop and personnel shall seek proper shelter (e.g., substantial building, enclosed vehicle, etc.). Work shall not resume until the threat of lighting has subsided and no lightning or thunder has been observed for 30 minutes. If the possibility of lightning is forecast for the day, advise the onsite personnel on the risks and proper procedure at the pre-work safety briefing. Continuously monitor for changing weather conditions and allow enough time to properly stop work if lightning is forecast.

7.3 Environmental Stressors, Heat Stress, Heat Exhaustion, and Heat Stroke

It is the employer's responsibility to monitor weather forecasts and ambient air temperatures, both prior to the work shift and during the shift. The National Oceanic and Atmospheric Administration records average minimum/maximum temperatures of 30/70 degrees Fahrenheit during the year in Brooklyn, NY.

To prevent potential heat illness, the following strategies will be implemented:

- Adjusting personnel work/rest intervals;
- Monitoring for symptoms of heat illness;
- Providing shaded rest areas;
- Providing cool potable water so that each employee has access to at least one quart per hour for the entire shift, free of charge;
- Allowing for employees to acclimatize to the weather conditions and work demands;
- Observe workers during a heat wave (i.e., when the temperature is at least 80^{o}F, and 10 degrees hotter than the average temperature of the five preceding days); and
- Implementing high heat procedures when the temperature reaches 95^{o}F.

Roux's Heat Illness Prevention Plan is implemented when the when ambient temperatures exceed 80°F. Roux's Heat Illness Prevention Program can be found within **Appendix E**. Additional information regarding heat illnesses is provided below. This can include, but is not limited to, access to shade that is sufficient in size to fit all workers who are on break; a car with air conditioning is acceptable, too. Preventative cool-down breaks shall be allowed at any time, and anyone taking such a break will be monitored for heat illness symptoms and not required to return to work until all symptoms (if present) of heat illness have disappeared. If necessary, first aid will be offered, but if symptoms are severe, emergency response procedures will be implemented per Section 6.3. Anyone who has shown symptoms of severe heat illness will not be sent home without being offered first aid or medical treatment.

High heat procedures must be implemented when temperatures reach 95°F. These procedures include:

- Ensuring that effective communication by voice, observation, or electronic means is maintained so that employees at the work site can contact a supervisor when necessary. An electronic device, such as a cell phone or text messaging device, may be used for this purpose only if the reception in the area is reliable.
- Observing employees for alertness and signs or symptoms of heat illness. The employer shall ensure effective employee observation/monitoring by implementing one or more of the following:
    - Supervisor or designee observation of 20 or fewer employees;
    - Mandatory buddy system; and
    - Regular communication with sole employee such as by radio or cellular phone, or other effective means of observation.
- Designating one or more employees on each worksite as authorized to call for emergency medical services and allowing other employees to call for emergency services when no designated employee is available.
- Encouraging employees throughout the work shift to drink plenty of water.
- A review of the high heat procedures during the daily tailgate meeting and remind employees of their right to take a cool-down rest when necessary.

7.3.1 Heat Stress

Heat stress is the body's response to excessive heat and can be a significant potential hazard. The risk of heat stress can be increased with heavy physical activity and/or the use of personal protective equipment in hot, humid weather environments. There are also personal risk factors that can contribute to the risk of suffering from heat stress, such as obesity, water intake, alcohol and caffeine consumption, pregnancy, age, medication, etc. Heat illness includes heat cramps, heat exhaustion, heat syncope, and heat stroke.

7.3.2 Heat Cramps

Heat cramps may be brought on by prolonged exposure to heat. As an individual sweats, water and salts are lost by the body resulting in painful muscle cramps, typically in the legs.

First aid treatment includes, but is not limited to, shade, rest, and fluid replacement. Typically, the individual should recover within one-half hour while being monitored constantly. If the individual has not improved substantially within 30 minutes and the body temperature has not decreased, the individual should be transported to a hospital for medical attention.

Per Roux's Heat Illness Prevention Plan, employees shall have access to potable drinking water that is fresh, pure, suitably cool, free of charge and in sufficient quantities. Access to shade shall be present when temperatures exceed 80 degrees Fahrenheit and shall be available when temperatures do not exceed 80 degrees Fahrenheit.

7.3.3 Heat Exhaustion

Heat exhaustion may occur in an individual who has been exposed to excessive heat while working or exercising. The circulatory system of the individual fails as blood collects near the skin to rid the body of excess heat through transference. The signs and symptoms of heat exhaustion are as follows:

- Rapid and shallow breathing;
- Weak pulse;
- Cold and clammy skin with heavy perspiration;
- Skin appears pale;
- Fatigue and weakness;
- Dizziness; and
- Elevated body temperature.

First aid treatment includes, but is not limited to, cooling the victim, elevating the feet, and replacing fluids.

If the individual is not substantially improved within 30 minutes and the body temperature has not decreased, the individual should be transported to the hospital for medical attention.

7.3.4 Heat Stroke

Heat stroke occurs when an individual is exposed to excessive heat and stops sweating. This condition is classified as a MEDICAL EMERGENCY requiring immediate cooling of the victim and transport to a medical facility. The signs and symptoms of heat stroke are as follows:

- Dry, hot, red skin;
- Body temperature approaching or above 105^{o}F;
- Confusion, altered mental state, slurred speech;
- Seizures;
- Large (dilated) pupils; and
- Loss of consciousness – the individual may go into a coma.

First aid treatment requires immediate cooling and transportation to a medical facility. Heat stress is a significant hazard if any type of protective equipment (semi-permeable or impermeable) that prevents evaporative cooling when worn in hot weather environments.

7.4 Cold Stress

Cold stress is a danger at low temperatures and when the wind-chill factor is low. Prevention of cold-related illnesses is a function of whole-body protection. Adequate insulating clothing must be used when the air temperature is below 60°F. A work/rest regimen will be initiated when ambient temperatures and protective clothing cause a stressful situation. In addition, reduced work periods followed by rest in a warm area may be necessary in extreme conditions. The signs and symptoms of cold stress include the following:

- Severe shivering;
- Abnormal behavior;
- Slowing;
- Weakness;
- Stumbling or repeated falling;
- Inability to walk;
- Collapse; and/or
- Unconsciousness.

First aid requires removing the victim from the cold environment and seeking medical attention immediately. Also, prevent further body heat loss by covering the victim lightly with blankets. Do not cover the victim's face. If the victim is still conscious, administer hot drinks and encourage activity such as walking, wrapped in a blanket.

8. Safety Procedures

This section of the HASP presents the specific safety procedures to be implemented during Roux's activities at the Site in order to protect the health and safety of various on-site personnel. Minimum OSHA-mandated procedures are presented first, followed by client- and Site-specific procedures. Lastly, activity-specific procedures are discussed. These Site and activity-specific procedures supplement the general safety procedures included in Roux's Corporate Health and Safety Manual, which also must be followed in their entirely.

8.1 Training

At a minimum, Site personnel who will perform work in areas where there exists the potential for toxic exposure will be health and safety-trained prior to performing work onsite per OSHA 29 CFR 1910.120(e) and 29 CFR 1926.65(e). More specifically, all Roux, subcontractor, and other personnel engaged in sampling and remedial activities at the Site and who are exposed or potentially exposed to hazardous substances, health hazards, or safety hazards must have received at a minimum the 40 hour initial HAZWOPER training consistent with the requirements of 29CFR 1910.120(e)(3)(i) training and a minimum of 3 days' actual field experience under the direct supervision of a trained experienced supervisor, plus 8 hours of refresher training on an annual basis. Depending on tasks performed, less training may be permitted. Evidence of such training must be maintained at the Site at all times. Furthermore, all on-Site management and supervisory personnel directly responsible for or who supervise the employees engaged in Site remedial operations, must have received an additional 8 hours of specialized training at the time of job assignment on topics including, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques, plus 8 hours of refresher training on an annual basis. Additionally, all workers who will be required to don a respirator will be properly trained on their employer's Respiratory Protection Program, which also includes being medically cleared to wear a respirator and passed a fit test, at least initially prior to use, and then annually thereafter in accordance with 29 CFR 1910.134, Respiratory Protection.

Roux personnel training records are maintained in a corporate database with records available upon request from either the OHSM/SHSO/CHSD or Human Resources Department.

8.2 Site-Specific Safety Briefings for Visitors

A site-specific briefing is provided to all site visitors who enter this site beyond the site entry point. For visitors, the site-specific briefing provides information about site hazards, the site lay-out including work zones and places of refuge, the emergency alarm system and emergency evacuation procedures, and other pertinent safety and health requirements as appropriate.

8.3 HASP Information and Site-Specific Briefings for Workers

Site personnel review this HASP and are provided a Site-specific tailgate briefing prior to the commencement of work to ensure employees are familiar with this HASP and the information and requirements it contains, as well as the relevant JSAs included in **Appendix B**. Additional briefings are provided as necessary to notify employees of any changes to this HASP as a result of information gathered during on-going Site characterization and analysis of changing conditions. Conditions for which we schedule additional briefings include, but are not limited to: changes in site conditions, changes in the work schedule/plan, newly discovered hazards, and incidents occurring during Site work.

8.4 Medical Surveillance

The medical surveillance section of the Health and Safety Plan describes how worker health status is monitored at this site. Medical surveillance is used when there is the potential for worker exposure to hazardous substance at levels above OSHA Permissible Exposure Limits (PEL) or other published limits. The purpose of a medical surveillance program is to medically monitor worker health to ensure that personnel are not adversely affected by site hazards. The provisions for medical surveillance at this site are based on the site characterization and job hazard analysis found in Section 4 of this HASP and are consistent with OSHA requirements in 29 CFR 1910.120(f) as applicable.

8.4.1 Site Medical Surveillance Program

Medical surveillance requirements are based on a worker's potential for exposure as determined by the site characterization and job hazard analysis documented in Section 4 and JSAs within **Appendix B** of this HASP and in compliance with the requirements of 29 CFR 1910.120(f)(2). Based on site information and use of direct reading instruments, limited use of respirators (less than 30 days per year), and the absence of an employee-staffed HAZMAT team, a limited medical surveillance program is required and implemented at this site. The medical surveillance program provides that:

1. Workers assigned to tasks requiring the use of respirators receive medical examinations in accordance with 29 CFR 1910.134(e) to ensure they are physically capable to perform the work and use the equipment, and
2. If a worker is injured, becomes ill, or develops signs or symptoms of possible over-exposure to hazardous substance or health hazards, medical examinations are provided to that worker as soon as possible after the occurrence and as required by the attending physician.
3. These medical examinations and procedures are performed by or under the supervision of a licensed physician and are provided to workers free of cost, without loss of pay, and at a reasonable time and place. In addition, the need to implement a more comprehensive medical surveillance program will be re-evaluated after any apparent over-exposure.

8.4.2 Medical Recordkeeping Procedures

Medical recordkeeping procedures are consistent with the requirements of 29 CFR 1910.1020 and are described in the company's overall safety and health program. A copy of that program is available at our Islandia, New York office.

The following items are maintained in worker medical records:

- Respirator fit test and selection;
- Physician's medical opinion of fitness for duty (pre-placement, periodic, termination);
- Physician's medical opinion of fitness for respirator protection (pre-placement, periodic); and
- Exposure monitoring results.

8.4.3 Program Review

The medical program is reviewed to ensure its effectiveness. The Corporate Health and Safety Manager in coordination with the Human Resources Director is responsible for this review. At minimum, this review consists of:

- Review of accident and injury records and medical records to determine whether the causes of accidents and illness were promptly investigated and whether corrective measures were taken wherever possible;
- Evaluation of the appropriateness of required medical tests based on site exposures; and
- Review of emergency treatment procedures and emergency contacts list to ensure they were site-specific, effective, and current.

8.5 Personnel Protection

Site safety and health hazards are eliminated or reduced to the greatest extent possible through engineering controls and work practices. Where hazards are still present, a combination of engineering controls, work practices and PPE are used to protect employees. Appropriate personal protective equipment (PPE) shall be worn by Site personnel when there is a potential exposure to chemical, biological or physical hazards (e.g., falling objects, flying particles, sharp edges, electricity, and noise), as determined by the SHSO. The level of personal protection, type and kind of equipment selected will depend on the hazardous conditions and in some cases cost, availability, compatibility with other equipment, and performance. An accurate assessment of all these factors will be made before work can be safely executed.

Roux maintains a comprehensive written PPE program that addresses proper PPE selection, use, maintenance, storage, fit and inspection. Roux's PPE program can be found within **Appendix F**. PPE to be used at the Site will meet the appropriate American National Standards Institute (ANSI) standards and the following OSHA (General/Construction Industry) standards for minimum PPE requirements.

The minimum level of PPE for entry onto the Site is Level D. The following equipment shall be worn:

- Work uniform (long pants, sleeved shirt);
- Hard hat;
- Steel or composite toe work boots (must comply with American Society for Testing and Materials [ASTM]) F 2412-05, Standard Test Methods for Foot Protection and ASTM F 2413-05, Standard Specification for Performance Requirements for Foot Protection);
- Safety Glasses (must comply with one of the following ANSI/ISEA Z87.1-2010, ANSI Z87.1-2003, ANSI Z87.1-2003);
- Boot Covers (as needed);
- Hearing protection (as needed);
- High visibility clothing (shirt/vest); and
- Hand protection (e.g., minimum cut resistance meeting ANSI 105-2000 Level 2).

Note that jewelry shall be removed or appropriately secured to prevent it from becoming caught in rotating equipment or unexpectedly snagged on a fixed object (e.g., wrist watches, bracelets, rings, chains and necklaces, open earrings). Do not wear loose clothing and all shoulder-length hair should be tied back.

Site specific PPE ensembles and materials are identified within task specific JSAs located within **Appendix B**, and any upgrades or downgrades of the level of protection (i.e., not specified in the JSA) must be approved by the PP and immediately communicated to all Roux personnel and subcontractors as applicable. PPE is used in accordance with manufacturer's recommendations.

8.5.1 Additional Personal Protection

As outlined above the minimum PPE for entry onto the Site is modified Level D. Outlined below are the requirements for Level C and B PPE.

EPA Level C Protection

Personal Protective Equipment:

- Full-face, air-purifying, cartridge-equipped respirator* (Mine Safety and Health Administration/ National Institute of Occupational Safety and Health [MSHA/ NIOSH] specifically approved for protection from organic vapors or particulates);
- Chemical-resistant clothing (coverall; hooded, two-piece chemical splash suit; chemical-resistant hood and apron; disposable chemical-resistant coveralls);
- Cotton coveralls;
- Gloves (outer), chemical-resistant, nitriles;
- Gloves (inner), cut resistant (with minimum blade cut-rating of ANSI 105-2000 Level 2);
- Boots (inner), chemical-resistant, steel (or composite) toe and including task-specific boot requirements as consistent with ASTM F2413-11;
- Boots (outer), chemical-resistant (disposable);
- Hard hat;
- Hearing protection (as needed); and
- Escape mask (as needed).

*Cartridges in use will be changed out based on their End of Service Life Indicator. If organic vapor (OV) cartridges are worn for benzene exposures above 1 ppm, the cartridge shall be removed from service at the end of the calculated service life or before the next shift, whichever is sooner. For other contaminants present a cartridge change out schedule will be provided based off 3M Select & Service Life Software or in consultation with the CHSD; worst case assumptions will be made to provide a conservative estimate on cartridge change out. If multiple contaminants are present at varying degrees, the work must cease operation, as cartridges in use may not cover all contaminants present. Screening will be carried out during work activities as specified in Section 8.6 Air Monitoring Plan. Organic vapors adsorbed on an organic vapor cartridge can migrate through the carbon bed without airflow. Desorption of the contaminant after partial use of the chemical cartridge can occur after a short period (hours) without use (e.g., overnight). This is most significant for the most volatile and poorly retained organic vapors (e.g., boiling point < 65 degrees Celsius [^{o}C]). For organic vapors with a boiling point less than 65 degrees C, it is recommended that the organic vapor cartridge never be used longer than one shift, even if the estimated service life is greater than 8 hours, and the cartridge is used for only a short time during the shift.

Criteria for Selection-Level C:

Meeting any of these criteria warrants use of Level C protection.

- Airborne hazards are known to be present but are unlikely to exceed protection factors provided by air purifying respirators.

- Continuous total organic vapor readings in the breathing zone register between 50 ppm and to less than 100 ppm on a PID (such as a MiniRAE 3000 or other comparable instrument), and chemical specific (e.g., benzene/vinyl chloride/formaldehyde) readings utilizing colorimetric indicator tubes (e.g., Dräeger or Sensidyne) are undetectable.
- See the Combustible Gases table for decisions based on LEL within Section 8.5. Air Monitoring Plan.
- Measured air concentrations of known organic vapors will be reduced by the respirator to at or below one half of the PEL, and the individual and combined compound concentrations are within the service limit of the respirator cartridge.
- Atmospheric contaminant concentrations do not exceed Immediately Dangerous to Life and Health (IDLH) concentrations.
- Atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect the small area of skin left unprotected by chemical-resistant clothing.
- Job functions have been determined not to require self-contained breathing apparatus.

Notes: 1. Benzene and or other specific compounds may also be monitored initially and periodically in the breathing zone utilizing activated sampling devices approved for use based on lower occupational exposure limits.

2. Modifications of Level C will be used to increase or decrease the level of skin protection during activities that increase or preclude, respectively, the degree of contact with chemical hazards. Modifications for increased protection may include, but are not limited to, the use of chemical resistant coveralls (e.g., Tyveks) and cut and chemical resistant gloves. Any modifications to Level C will require approval of the SHSO, and PM in consultation with the CHSD.

EPA Level B Protection (Contact the OHSM and/or CHSD)

Personal Protection Equipment:

- Pressure-demand, self-contained breathing apparatus (MSHA/NIOSH approved);
- Chemical-resistant clothing (overall and long-sleeved jacket; coveralls; hooded, one or two-piece chemical-splash suit; disposable chemical-resistant coveralls);
- Cotton coveralls;
- Chemical-resistant gloves (outer) nitriles;
- Gloves (inner), cut-resistant (with minimum blade cut rating of ANSI Level 2);
- Boots (inner), chemical-resistant, steel (or composite) toe, and task-specific boot requirements as consistent with ASTM F2413-11;
- Boots (outer), chemical-resistant, (disposable);
- Hard hat;
- Hearing protection (as needed); and
- 2-way radio communications (intrinsically safe).

Criteria for Selection-Level B:

- Meeting any one of these criteria warrants use of Level B protection.
- PID instrument (such as a MiniRAE 3000 or other comparable instrument) readings in the breathing zone are greater than 50 ppm and less than 100 ppm and benzene is detectable utilizing colorimetric indicator tubes (e.g., Dräeger or Sensidyne).
- Airborne hazards are known to be present but are not identified or quantified.

- The type(s) and atmospheric concentration(s) of toxic substance(s) have been identified and require the highest level of respiratory protection, but a lower level of skin and eye protection. These would-be atmospheres:
    - With IDLH concentrations;
    - Exceeding limits of protection afforded by a full-face, air-purifying respirator; or
    - Containing substances requiring supplied-air PPE, but substances and/or concentrations do not represent a serious skin hazard.
    - The atmosphere contains less than 19.5% oxygen.
- Site operations make it highly unlikely that the small, unprotected area of the head or neck will be contacted by splashes of extremely hazardous substances.
- If work is performed in an enclosed space.

Note that jewelry shall be removed or appropriately secured to prevent it from becoming caught in rotating equipment or unexpectedly snagged on a fixed object. (e.g., wrist watches bracelets, rings, chains and necklaces, open earrings). Do not wear loose clothing and all shoulder length hair should be tied back.

Site-specific PPE ensembles and materials are identified within task specific JSAs located within **Appendix B**, and any upgrades or downgrades of the level of protection (i.e., not specified in the JSA) must be immediately communicated to all Roux personnel and subcontractors, as applicable. PPE is used in accordance with manufacturer's recommendations.

8.5.2 Hearing Conservation

Hearing protection is made available when noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 dBA. Hearing protection is required when the 8-hour time weighted average sound level $\geq$ 85 dBA, or when noise levels exceed 140 dBA at any point or exceeds 115 dBA for at least 15 minutes. Where noise exposure meets or exceeds this level, noise is listed as a physical hazard in the JSA for the tasks/operation, and hearing protection is included as one of the control measures (PPE).

8.6 Monitoring

An air monitoring program is important to the safety of on- and off-Site personnel, and the surrounding area. A preliminary survey, to establish background conditions in the immediate sampling area, may be made prior to the initiation of Site work including, but not limited to, monitoring wind direction (e.g., wind socks) and approximate temperature during all invasive Site activities. This survey will be conducted with the appropriate pre-calibrated air monitoring instrument(s), as warranted by the field activity. Once this survey has been complete, any changes in the type of PPE will be determined and relayed to those working on-Site.

Work zone air monitoring will be performed to verify that the proper level of PPE is used, and to determine if increased protection or work stoppage is required. The following equipment shall be used to monitor conditions:

- A Photoionization Detector (PID) with a lamp energy of 10.6 eV will be used to provide direct readings of organic vapor concentrations during intrusive activities to determine that personnel protection is adequate. Concentrations shall be recorded during intrusive activities with the potential to encounter contaminant vapors.
- A pre-calibrated multi-gas meter with combustible Lower Explosive Limit (LEL), oxygen (O2), carbon monoxide (CO), and hydrogen sulfide (H2S) sensors shall be used to monitor the potential for

oxygen-deficient atmospheres, explosive concentrations of organic vapors, and toxic gases during intrusive operations. The calibration for this device will be performed using a known gas composition calibration mixture.

Personal exposure monitoring utilizing activated charcoal tubes may be considered based on whether or not the area sample results are at or above half of the PEL. The decision to perform the monitoring will be made by, and under the control of, the CHSD.

Below are monitoring action levels for Site-specific chemicals of concern. In the event PID readings above the thresholds identified below are sustained for 5 minutes in the breathing zone, worker protection will require upgrading following notification to the OHSM and applicable parties.

8.6.1 Action Levels for Air Monitoring

PPE can remain at Level D if breathing zone VOC concentrations are less than 5 ppm and benzene is non-detect. Personnel are required to evacuate the Site when breathing zone VOC readings exceed 25 ppm.

The following tables include summaries of the air monitoring, work practices, and action levels for the expected contaminants. The action levels to initiate testing with colorimetric tubes for airborne volatiles is 1 ppm (PID reading) and is based on the Permissible Exposure Limit (PEL) for benzene (1 ppm). The colorimetric tubes are used to confirm the presence or absence of specific constituents, and they do not provide a measured concentration.

PPE can remain at Level D if breathing zone VOC concentrations are less than 5 ppm and is non-detect. Personnel are required to evacuate the Site when breathing zone VOC readings exceed 25 ppm.

The following tables include summaries of the air monitoring, work practices, and action levels for the expected contaminants

Air Monitoring Summary and Action Levels Organic Vapors	
PID Reading in Breathing Zone (ppm)	**Action**
0-1 ppm above background	Continue monitoring
>1-5 ppm sustained 60 seconds	Continue monitoring, if applicable initiate additional collection of benzene/vinyl chloride/formaldehyde using colorimetric tubes.
<5 ppm and no presence of benzene/vinyl chloride/formaldehyde	Continue Monitoring, ventilate space
≥ 5 ppm - ≤ 25 ppm and no presence of benzene/vinyl chloride/formaldehyde	Ventilate space until PID reads < 5 ppm. If < 5 ppm cannot be achieved, upgrade to Level C[1].
≥ 25 ppm	Ventilate space and evacuate area. Consult with CHSD.

Background concentrations should be established at the beginning of each work day. It may be necessary to re-establish background concentrations and ambient conditions vary through the day.

1 Measured air concentrations of known organic vapors will be reduced by the respirator to one half of the PEL or lower, and the individual and combined compound concentrations shall be within the service limit of the respirator cartridge.

Air Monitoring Summary and Action Levels Oxygen	
O_2 Reading in Breathing Zone (%)[1]	Action
20.9% O_2	Oxygen level normal
< 19.5% O_2	Oxygen deficient Interrupt task/Evacuate area
>23.5% O_2	Oxygen enriched Interrupt task/Evacuate area

1. Action levels based on USEPA Standard Operating Safety Guides; Table 5-1

Air Monitoring Summary and Action Levels Carbon Monoxide	
CO Reading in Breathing Zone (ppm)[1]	Action
<12.5 ppm	Inspect exhaust system for leaks or other sources of CO. Monitor initially and every 15 minutes during use of CO-generating equipment.
12.5-25 ppm	Ventilate area. Monitor continuously and record measurements. Contact PM.
>25 ppm	Cease Field Operations. Ventilate area.

[1] Based upon the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 25 ppm as an 8-hour time weighted average (TWA) and OSHA's Permissible Exposure Limit (PEL) of 50 ppm as an 8-hour TWA concentration.

Air Monitoring Summary and Action Levels Combustible Gases	
Lower Explosive Limit (LEL) Reading	Action
< 4% LEL	Site activities will continue with normal monitoring
4% – 20% LEL	Stop work until levels dissipate to <4% LEL
> 20% LEL	Potential explosion hazard. Halt all site activities, research source of release, aerate work area, suppress source.

Air Monitoring Summary and Action Levels Hydrogen Sulfide	
Hydrogen Sulfide (H_2S) Reading	**Action**
<10 ppm	Site activities will continue with normal monitoring
≥10 ppm	Stop work until levels dissipate to <10 ppm; use mechanical ventilation if possible. Consult with CHSD if unable to reduce concentrations below 10 ppm.

8.6.2 Explosive Hazard

Methane is a common gas constituent that is generated during the decomposition of organics. Methane, a non-toxic compound, does not have an OSHA PEL or other exposure limits based on toxicity. However, methane is explosive under certain conditions. The Lower Explosive Limit (LEL) for methane is 5% in air, or 50,000 parts per million by volume. At high concentrations, methane can also displace oxygen and cause asphyxiation. Because methane is lighter than air, it does not tend to accumulate in low-lying areas and will rapidly mix with atmospheric air if encountered during drilling activities. Methane concentrations will be continuously monitored using a pre-calibrated gas meter while excavation takes place.

8.6.3 Air Monitoring Equipment and Calibration

A PID calibrated to an appropriate calibration mixture will be used to detect organic vapors in and around the work areas. Monitoring will be conducted in and around all work areas and at the workers breathing zone before activities commence to establish a background level, then at 15-minute intervals throughout the day. All equipment will be calibrated according to the manufacturer’s recommendation. A calibration log will be maintained and will include the name of the person who performed the calibration, the date and time calibrated, and the instrument reading at the time of calibration. A manual bellows pump or equivalent with colorimetric tubes for specific compounds will be utilized to determine the course of action related to upgrading or downgrading the level of respiratory protection, as applicable.

If air monitoring data indicate safe levels of potentially harmful constituents at consistent intervals (5-minute intervals), then monitoring can be conducted less frequently (every 30 minutes). This determination will be made by the onsite SHSO. Monitoring data, including background readings and calibration records, will be documented. Work to be performed on-Site will conform to Roux’s Standard Operating Procedures (SOPs). Conformance with these guidelines as well as the guidelines described in this HASP will aid in mitigating the physical and chemical hazards mentioned throughout this HASP.

8.7 Tailgate Safety Meetings

A designated Site worker will provide daily safety briefings (e.g., tailgate meetings) including, but not limited to, the following scenarios:

- When new operations are to be conducted;
- Whenever changes in work practices must be implemented; and
- When new conditions are identified and/or information becomes available.

Daily safety briefings shall be recorded on the Roux Daily Tailgate Health and Safety Meeting Log/Daily Site Safety Checklist, and all completed forms will become a part of the project file.

8.8 Spill Containment

Spill containment equipment and procedures should, at a minimum, meet the requirements of the facility's Spill Prevention, Control and Countermeasure Plan, if applicable. Otherwise, spill containment equipment and procedures must be considered depending on the task, including, but not limited to, chemical/product transfer points and handling.

8.8.1 Initial Spill Notification and Response

Any worker who discovers a hazardous substance spill will immediately notify the SHSO. The worker will, to his/her best ability, report the hazardous substance involved, the location of the spill, the estimated quantity of material spilled, the direction/flow of the spill material, related fire/explosion incidents, and any associated injuries without compromising their own safety.

8.8.2 Spill Evaluation and Response

The SHSO is responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area will be isolated and demarcated to the extent possible. If necessary to protect nearby community members, notification of the appropriate authorities is made by the PM as appropriate. On-Site response is limited to small spills (e.g., <10 gallons); large spills require external emergency responders who will be contacted by the SHSO.

8.9 Decontamination

The decontamination section of the HASP describes how personnel and equipment are decontaminated when they leave the Exclusion Zone. This section also describes how residual waste from decontamination processes is disposed. The site decontamination procedures are designed to achieve an orderly, controlled removal or neutralization of contaminants that may accumulate on personnel or equipment. These procedures minimize worker contact with contaminants and protect against the transfer of contaminants to clean areas of the site and off-site. They also extend the useful life of PPE by reducing the amount of time that contaminants contact and can permeate PPE surfaces. Decontamination is facilitated within the CRZ at this site, if applicable.

8.9.1 Decontamination Procedures for Personnel and PPE

The following are general decontamination procedures established and implemented at this site.

1. Decontamination is required for all workers exiting a contaminated area. Personnel may re-enter the SZ only after undergoing the decontamination procedures described below in the next section.
2. Protective clothing is decontaminated, cleaned, laundered, maintained and/or replaced as needed to ensure its effectiveness.
3. PPE used at this site that requires maintenance or parts replacement is decontaminated prior to repairs, or
4. PPE used at this site is decontaminated or prepared for disposal on the premises. Personnel who handle contaminated equipment have been trained in the proper means to do so to avoid hazardous exposure.

5. This site uses an off-site laundry for decontamination of PPE. The site has informed that facility of the hazards associated with contaminated PPE from this site.
6. The site requires and trains workers that if their permeable clothing is splashed or becomes wetted with a hazardous substance, they will immediately exit the work zone, perform applicable decontamination procedures, shower, and change into uncontaminated clothing.
7. Procedures for disposal of decontamination waste meet applicable local, State, and Federal regulations.

8.9.2 Decontamination Procedures for Equipment

All tools, equipment, and machinery from the EZ or CRZ are decontaminated in the CRZ prior to removal to the SZ. Equipment decontamination procedures are designed to minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities.

General Equipment Decontamination Procedures:

1. Decontamination is required for all equipment exiting a contaminated area. Equipment may re-enter the SZ only after undergoing the equipment decontamination procedures.
2. Vehicles that travel regularly between the contaminated and clean areas of the site are carefully decontaminated each time they exit the EZ and the effectiveness of that decontamination is monitored to reduce the likelihood that contamination will be spread to other parts of the site.
3. Particular attention is given to decontaminating tires, scoops, and other parts of heavy equipment that are directly exposed to contaminants and contaminated soil.
4. Procedures for disposal of decontamination waste shall meet applicable local, State, and Federal regulations.

The following items may be used to decontaminate equipment:

- Fresh water rinse;
- Non-phosphorus detergent wash;
- Acetone rinse;
- Distilled water rinse; and
- A steam cleaner or pressure washer (heavy equipment only).

8.9.3 Monitoring the Effectiveness of Decontamination Procedures

Visual examination and sampling are used to evaluate the effectiveness of decontamination procedures. Visual examination is used to ensure that procedures are implemented as described and that they appear to control the spread of contaminants under changing site conditions. Visual examination is also used to inspect for signs of residual contamination or for contaminant permeation of PPE.

Personnel who work in contaminated areas of the site, either the Contamination Reduction Zone (CRZ) or the Exclusion Zone, are trained in the principles and practices of decontamination described in this section of the HASP and in related SOPs. If site procedures are changed as a result of inspection and monitoring, all affected employees are notified of these changes.

8.10 Confined Space Entry

Confined space entry will not be performed.

The following is a list of the safety requirements for confined space entry at the Site:

- **ROUX PERSONNEL ARE NOT AUTHORIZED TO ENTER AN OSHA PERMIT REQUIRED CONFINED SPACE;**
- Currently the scope of work **DOES NOT** require personnel to enter permitted confined space for this project; and
- Any changes to the field activities that may necessitate confined space entry will be reported to the Project Principal and OHSM.

Confined space is defined as any space, depression, or enclosure that:

- Has limited opening for entry and egress;
- Is large enough for and employee to enter and perform assigned work; and
- Is not intended for continuous occupancy.

A permit required confined space is one that meets the definition of a confined space and has one or more of the following characteristics:

- May contain or produce life-threatening atmospheres due to oxygen deficiency the presence of toxic, flammable, or corrosive contaminants;
- Contains a material that has the potential for engulfment;
- Has an internal configuration that may cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; and
- Contains any other serious safety or health hazards.

Although Roux personnel will not perform confined space entry, it is expected that subcontractors performing cleaning and mitigation and/or remedial measures activities may be required to enter structures that are considered to be a permit required confined space. Permitting of the confined space as well as hazard mitigation for entry will be completed by the subcontractor in accordance with 29 CFR 1910.146 or 1926.1201-1213 and/or applicable local/client requirements.

8.11 Client and Site-Specific

In addition to the OSHA-specific procedures discussed above, there may be client and site-specific safety procedures that must be adhered to during the performance of remedial activities at the Site.

8.12 Unusual or Significant Risks

Field activities that appear to have unusual or significant risks that cannot be adequately managed with existing risk tools such as LPS, HASPs, traffic safety plans, work permits, design and O&M practices, equipment HAZOPS or other safety tools must be referred to the CHSD to help with the assessment and management of the associated potential safety risks. Examples include the use of explosives for demolition, use of firearms to control wildlife, rappelling, demolition over water, diving, etc.

8.13 Activity-Specific Hazards

In addition to the general hazards discussed above, there are activity-specific hazards associated with each work activity planned for the Site. An activity-specific JSA has been completed for each of the activities planned for the Site. JSAs are provided in **Appendix B**. In the event that new work activities or tasks are planned, JSAs will be developed and implemented prior to performing the new activities. In the absence of a JSA, the personnel performing work must prepare a field JSA and receive clearance from a designated competent safety official prior to performing any task with significant risk. In emergency situations where time is critical SPSAs will be utilized to identify the task, associated hazards and mitigative actions to take. For lower risk activities (as deemed by the discretion of a Competent Person) where a JSA is determined to not be needed, the individual(s) conducting the activities must perform SPSAs prior to and during the work.

8.13.1 Electrical and Other Utility Assessment and Accommodations

Roux shall perform a site walk to identify any potential overhead electrical or utility lines. All applicable guidelines will be followed in the vicinity of overhead power and utility lines (see Section 8.13.3 below).

Roux has also reviewed all available Site maps showing buried utility lines to identify potential hazards, which revealed that no underground hazards are known to exist in the vicinity of the areas of the Site pertinent to this HASP.

8.13.2 Subsurface Work

Subsurface work activities will require adherence to Roux's Corporate Subsurface Utility Clearance Management program found within **Appendix G**.

8.13.3 Heavy Equipment

Use of heavy equipment at the Site will require adherence to Roux's Corporate Heavy Equipment Exclusion Zone Management Program found within **Appendix H**. Additionally, operation of the drill rig/other heavy equipment will maintain clearances from overhead power lines in accordance with 29 CFR 1926.1408 Table A Minimum Clearance Distances provided below.

Minimum Required Clearances for Energized Overhead Power Lines

Nominal System Voltage of Power Line (K V)	Minimum Required Clearance (feet)
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

1 kilovolt (KV) = 1,000 volts

8.14 Traffic Control

If Site operations encroach upon public streets or highways and a hazard exists to Site personnel because of traffic conditions, a traffic control plan will be implemented in accordance with the United States Department of Transportation's (DOT's) "Manual on Uniform Traffic Control Devices."

8.15 Sanitation

Sanitation facilities will be provided in accordance with the sanitation standards (29 CFR 1910.141, 29 CFR 1926.51 and 29 CFR 1928.110). Sanitation facilities will be maintained and kept in good conditions at all times.

9. Field Team Review

Each person performing work at or visiting this site shall sign this section after site-specific training is completed and before being permitted to access the CRZ or Exclusion Zone.

I have read and understand this Site-Specific Health and Safety Plan. I will comply with the provision contained therein.

Site/Project: 268 Bergen Street, 287 Wyckoff Street and N/A Wyckoff Street

Name & Company	Signature	Date

10. Approvals

By their signature, the undersigned certify that this HASP is approved and will be utilized at the 280 Bergen Street Site.

TBD – Site Health and Safety Officer

Date

Nevin Pahlad - Office Health and Safety Manager

Date

Julia Michaels – Project Manager

Date

Robert Kovacs – Project Principal

Date

TABLES

1. Toxicological Properties of Hazardous Substances Present at the Site

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
ORGANOCHLORINE PESTICIDES (OCP)									
DDT	50-29-3	TWA 1 mg/m3	TWA 0.5 mg/m3	TWA 1 mg/m3	500 mg/m3	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; paresthesia tongue, lips, face; tremor; anxiety, dizziness, confusion, malaise (vague feeling of discomfort), headache, lassitude (weakness, exhaustion); convulsions; paresis hands; vomiting; [potential occupational carcinogen]	Eyes, skin, central nervous system, kidneys, liver, peripheral nervous system	White, odorless and tasteless, very stable, water-insoluble, synthetic BP: 260°F Fl.Pt. = 162-171°F LEL: NA UEL: NA
Aldrin	309-00-2	TWA 0.1 mg/m3	TWA 0.25 mg/m3	TWA 0.25 mg/m3	25 mg/m3	Inhalation, ingestion, skin and/or eye contact	headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort); myoclonic jerks of limbs; clonic, tonic convulsions; coma; hematuria (blood in the urine), azotemia; [potential occupational carcinogen]	Developmemntal, Endocrine, Liver, Immune System, Nervous System,	Colorless to dark-brown crystalline solid with a mild chemical odor. BP: 293°F Fl.Pt. = 150°F LEL: NA UEL: NA
Lindane (gamma-BHC)	58-89-9	TWA 0.5 mg/m3	TWA 0.5 mg/m3	TWA 0.5 mg/m3	50 mg/m3	Inhalation, ingestion, skin and/or eye contact	irritation eyes, skin, nose, throat; headache; nausea; clonic convulsions; resp difficulty; cyanosis; aplastic anemia; muscle spasm; In Animals: liver, kidney damage	Eyes, skin, respiratory system, central nervous system, blood, liver, kidneys	White to yellow, crystalline powder with a slight, musty odor. BP: 614°F Fl.Pt. = 150°F LEL: NA UEL: NA
Dieldrin	860-57-1□	TWA 0.1 mg/m3	TWA 0.25 mg/m3	TWA 0.25 mg/m3	25 mg/m3	Inhalation, ingestion, skin and/or eye contact	headache, dizziness; nausea, vomiting, malaise (vague feeling of discomfort), sweating; myoclonic limb jerks; clonic, tonic convulsions; coma; ; In Animals: liver, kidney damage [potential occupational carcinogen]	Developmemntal, Endocrine, Liver, Immune System, Nervous System,	Colorless to light-tan crystals with a mild, chemical odor. BP: NA (Decomposes) Fl.Pt. = NA LEL: NA UEL: NA
VOLATILE ORGANIC COMPOUNDS (VOCs)									
1,1,1-Trichloroethane	71-55-6	TWA 350 ppm STEL 450 ppm	C 350 ppm (1900 mg/m^3) [15-minute]	TWA 350 ppm (1900 mg/m^3)	700 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, central nervous system, cardiovascular system, liver	Colorless liquid with a mild, chloroform-like odor. BP: 165°F Fl.Pt. = NA LEL: 7.5% UEL: 12.5% Combustible Liquid, but burns with difficulty
1,1,2,2-Tetrachloroethane	79-34-5	TWA 1 ppm [skin]	Ca TWA 1 ppm (7 mg/m^3) [skin]	TWA 5 ppm (35 mg/m^3) [skin]	Ca [100 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Nausea, vomiting, abdominal pain; tremor fingers; jaundice, hepatitis, liver tenderness; dermatitis; leukocytosis (increased blood leukocytes); kidney damage; [potential occupational carcinogen]	Skin, liver, kidneys, central nervous system, gastrointestinal tract	Colorless to pale-yellow liquid with a pungent, chloroform-like odor BP: 296°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Liquid
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	TWA 1000 ppm STEL 1250 ppm	TWA 1000 ppm (7600 mg/m3) ST 1250 ppm (9500 mg/m3)	TWA 1000 ppm (7600 mg/m3)	2000 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation skin, throat, drowsiness, dermatitis; central nervous system depression; In Animals: cardiac arrhythmias, narcosis	Skin, heart, central nervous system, cardiovascular system	Colorless to water-white liquid with an odor like carbon tetrachloride at high concentrations. [Note: A gas above 118°F.] BP: 118°F Fl.Pt. = NA LEL: NA UEL: NA
1,1,2-Trichloroethane	79-00-5	TWA 10 ppm [skin]	Ca TWA 10 ppm (45 mg/m3) [skin]	TWA 10 ppm (45 mg/m3) [skin]	Ca [100 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose; central nervous system depression; liver, kidney damage; dermatitis; [potential occupational carcinogen]	Eyes, respiratory system, central nervous system, liver, kidneys	Colorless liquid with a sweet, chloroform-like odor BP: 237°F Fl.Pt. = NA LEL: 6% UEL: 15.5% Combustible Liquid, forms dense soot
1,1-Dichloroethane	75-34-3	TWA 100 ppm	TWA 100 ppm (400 mg/m^3)	TWA 100 ppm (400 mg/m^3)	3,000 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation skin; central nervous system depression; liver, kidney, lung damage	Skin, liver, kidneys, lungs, central nervous system	Colorless, oily liquid with a chloroform-like odor. BP: 135°F Fl.Pt. = 2°F LEL: 5.4% UEL: 11.4% Class IB Flammable Liquid Fl.P. below 73°F and BP at or above 100°F.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
1,1-Dichloroethene	75-35-4	TWA 5 ppm	Ca	None	Ca	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, throat; dizziness, headache, nausea, dyspnea (breathing difficulty); liver, kidney disturbance; pneumonitis; [potential occupational carcinogen]	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Colorless liquid or gas (above 89°F) with a mild, sweet, chloroform-like odor BP: 89°F Fl.Pt. = -2°F LEL: 6.5% UEL: 15.5% Class IA Flammable Liquid: Fl.P. below 73°F and BP below 100°F
1,2,3-Trichlorobenzene	87-61-6	Cameo Chemicals Source https://cameochemicals.noaa.gov/chemical/10051	NA	NA	NA	Inhalation, skin absorption, ingestion, skin and/or eye contact	Inhalation may cause irritation of respiratory tract. Irritating to the eyes. May redden skin on contact. Ingestion may cause liver damage.	Skin, eyes, respiratory tract, liver	A white solid with a sharp chlorobenzene odor. Insoluble in water and denser than water. Hence sinks in water Fl.Pt. = 234.9°F
1,2,4-Trichlorobenzene	120-82-1	C 5 ppm	C 5 ppm (40 mg/m3)	None	N.D.	inhalation, skin absorption, ingestion, skin and/or eye contact	irritation eyes, skin, mucous membrane; In Animals: liver, kidney damage; possible teratogenic effects	Eyes, skin, respiratory system, liver, reproductive system	Colorless liquid or crystalline solid (below 63°F) with an aromatic odor BP: 416°F Fl.Pt. = 222°F LEL (302°F): 2.5% UEL (302°F): 6.6% Class IIIB Combustible Liquid: Fl.P. at or above 200°F. Combustible Solid
1,2-Dibromo-3-chloropropane	96-12-8	NA	Ca	TWA 0.001 ppm	Ca	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; drowsiness; nausea, vomiting; pulmonary edema; liver, kidney injury; sterility; [potential occupational carcinogen]	Eyes, skin, respiratory system, central nervous system, liver, kidneys, spleen, reproductive system, digestive system	Dense yellow or amber liquid with a pungent odor at high concentrations. [pesticide] [Note: A solid below 43°F.] BP: 384°F Fl.Pt. = (oc) 170°F LEL: NA UEL: NA Class IIIA Combustible Liquid: Fl.P. at or above 140°F and below 200°F.
1,2-Dibromoethane	106-93-4	None listed Skin	Ca TWA 0.045 ppm C 0.13 ppm [15-minute]	TWA 20 ppm C 30 ppm 50 ppm [5-minute maximum peak]	Ca [100 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system; dermatitis with vesiculation; liver, heart, spleen, kidney damage; reproductive effects; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys, reproductive system	Colorless liquid or solid (below 50°F) with a sweet odor. [fumigant] BP: 268°F Fl.Pt. = 50°F LEL: NA UEL: NA Noncombustible Liquid
1,2-Dichlorobenzene	95-50-1	TWA 25 ppm STEL 50 ppm	C 50 ppm (300 mg/m3)	C 50 ppm (300 mg/m3)	200 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose; liver, kidney damage; skin blisters	Eyes, skin, respiratory system, liver, kidneys	Colorless to pale-yellow liquid with a pleasant, aromatic odor. [herbicide] BP: 357°F Fl.Pt. = 1°F LEL: 2.2% UEL: 9.2% Class IIIA Combustible Liquid: Fl.P. at or above 140°F and below 200°F.
1,2-Dichloroethane	107-06-2	TWA 10 ppm	Ca TWA 1 ppm (4 mg/m3) ST 2 ppm (8 mg/m3)	TWA 50 ppm C 100 ppm 200 ppm [5-minute maximum peak in any 3 hours]	Ca [50 ppm]	Inhalation, ingestion, skin absorption, skin and/or eye contact	Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]	Eyes, skin, kidneys, liver, central nervous system, cardiovascular system	Colorless liquid with a pleasant, chloroform-like odor. [Note: Decomposes slowly, becomes acidic & darkens in color.] BP: 182°F Fl.Pt. = 56°F LEL: 6.2% UEL: 16% Class IB Flammable Liquid Fl.P. below 73°F and BP at or above 100°F.
1,2-Dichloropropane	78-87-5	TWA 10 ppm Dermal Sensitizer (DSEN)	Ca	TWA 75 ppm (350 mg/m3)	Ca [400 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system; drowsiness, dizziness; liver, kidney damage; In Animals: central nervous system depression; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys, central nervous system	Colorless liquid with a chloroform-like odor. [pesticide] BP: 206°F Fl.Pt. = 60°F LEL: 3.4% UEL: 14.5% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.
1,3-Dichlorobenzene	541-73-1	https://cameochemicals.noaa.gov/chemical/8514				Inhalation, skin absorption, ingestion, skin and/or eye contact	INHALATION: Causes headache, drousiness, unsteadiness. Irritating to mucous membranes. EYES: Severe irritation. SKIN: Severe irritation. INGESTION: Irritation of gastric mucosa, nausea, vomiting, diarrhea, abdominal cramps and cyanosis.		Colorless liquid. Sinks in water. BP: 343°F Fl.Pt. = 146°F LEL: 2.02% UEL: 9.2%
1,4-Dichlorobenzene	106-46-7	TWA 10 ppm	Ca	TWA 75 ppm (450 mg/m3)	Ca [150 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Eye irritation, swelling periorbital (situated around the eye); profuse rhinitis; headache, anorexia, nausea, vomiting; weight loss, jaundice, cirrhosis; In Animals: liver, kidney injury; [potential occupational carcinogen]	Liver, respiratory system, eyes, kidneys, skin	Colorless or white crystalline solid with a mothball-like odor. [insecticide] BP: 345°F Fl.Pt. = 150°F LEL: 2.5% UEL: NA Combustible Solid, but may take some effort to ignite.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
1,4-Dioxane	123-91-1	TWA 20 ppm [skin]	Ca C 1 ppm (3.6 mg/m3) [30-minute]	TWA 100 ppm (360 mg/m3) [skin]	Ca [500 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	irritation eyes, skin, nose, throat; drowsiness, headache; nausea, vomiting; liver damage; kidney failure; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys	Colorless liquid or solid (below 53°F) with a mild, ether-like odor. BP: 214°F Fl.Pt. = 55°F LEL: 2.0% UEL: 22% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F
2-Butanone	78-93-3	TWA 200 ppm STEL 300 ppm	TWA 200 ppm (590 mg/m3) ST 300 ppm (885 mg/m3)	TWA 200 ppm (590 mg/m3)	3000 ppm	inhalation, ingestion, skin and/or eye contact	irritation eyes, skin, nose; headache; dizziness; vomiting; dermatitis	Eyes, skin, respiratory system, central nervous system	Colorless liquid with a moderately sharp, fragrant, mint- or acetone-like odor BP: 175°F Fl.Pt. = 16°F LEL (200°F): 1.4% UEL (200°F): 11.4% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F
2-Hexanone	591-78-6	TWA 5 ppm STEL 10 ppm [skin]	TWA 1 ppm (4 mg/m3)	TWA 100 ppm (410 mg/m3)	1600 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose; peripheral neuropathy: lassitude (weakness, exhaustion), paresthesia; dermatitis; headache, drowsiness	Eyes, skin, respiratory system, central nervous system, peripheral nervous system	Colorless liquid with an acetone-like odor BP: 262°F Fl.Pt. = 77°F LEL: NA UEL: 8.0% Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F
4-Methyl-2-pentanone	108-10-1	TWA 20 ppm STEL 75 ppm	TWA 50 ppm (205 mg/m3) ST 75 ppm (300 mg/m3)	TWA 100 ppm (410 mg/m3)	500 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; headache, narcosis, coma; dermatitis; In Animals: liver, kidney damage	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Colorless liquid with a pleasant odor BP: 242°F Fl.Pt. = 64°F LEL (200°F): 1.2% UEL (200°F): 8.0% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F
Acetone	67-64-1	TWA 250 ppm STEL 500 ppm	TWA 250 ppm (590 mg/m^3)	TWA 1000 ppm (2400 mg/m^3)	2500 ppm [10% LEL]	Inhalation, ingestion, skin and/or eye contact	irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis	Eyes, skin, respiratory system, central nervous system	Colorless liquid with a fragrant, mint-like odor BP: 133°F Fl.Pt. = 0°F LEL: 12.8% UEL: 2.5% Class IB Flammable liquid: Fl.P. below 73°F and BP at or above 100°F.
Benzene	71-43-2	TWA 0.5 ppm STEL 2.5 ppm	Ca TWA 0.1 ppm ST 1 ppm	TWA 1 ppm ST 5 ppm	Ca [500 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]	Eyes, skin, respiratory system, blood, central nervous system, bone marrow	Colorless to light yellow liquid with an aromatic odor [Note: Solid below 42 °F] BP: 176°F Fl.Pt. = 12°F LEL: 1.2% UEL: 7.8% Class IB Flammable liquid. Fl.P. below 73°F and BP at or above 100°F.
Bromochloromethane	74-97-5	TWA 200 ppm	TWA 200 ppm (1050 mg/m3)	TWA 200 ppm (1050 mg/m3)	2000 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, throat; confusion, dizziness, central nervous system depression; pulmonary edema	Eyes, skin, respiratory system, liver, kidneys, central nervous system	Colorless to pale-yellow liquid with a chloroform-like odor. [Note: May be used as a fire extinguishing agent.] BP: 155°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Liquid
Bromodichloromethane	75-27-4	https://cameochemicals.noaa.gov/chemical/16064				Inhalation, ingestion, skin and/or eye contact	Symptoms of exposure to this compound may include irritation of the skin, eyes, mucous membranes and respiratory tract. It may also cause narcosis. Other symptoms may include nausea, dizziness and headache.	Liver and kidney damage. Central nervous system effects may also occur.	Clear colorless liquid BP: 189°F Fl.Pt. = NA LEL: NA UEL: NA
Bromoform	75-25-2	TWA 0.5 ppm	TWA 0.5 ppm (5 mg/m3) [skin]	TWA 0.5 ppm (5 mg/m3) [skin]	850 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system; central nervous system depression; liver, kidney damage	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Colorless to yellow liquid with a chloroform-like odor. [Note: A solid below 47°F.] BP: 301°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Liquid
Bromomethane	74-83-9	TWA 1 ppm [skin]	Ca	C 20 ppm (80 mg/m3) [skin]	Ca [250 ppm]	Inhalation, skin absorption (liquid), skin and/or eye contact (liquid)	Irritation eyes, skin, respiratory system; muscle weak, incoordination, visual disturbance, dizziness; nausea, vomiting, headache; malaise (vague feeling of discomfort); hand tremor; convulsions; dyspnea (breathing difficulty); skin vesiculation; liquid: frostbite; [potential occupational carcinogen]	Eyes, skin, respiratory system, central nervous system	Colorless gas with a chloroform-like odor at high concentrations. [Note: A liquid below 38°F. Shipped as a liquefied compressed gas.] BP: 38°F Fl.Pt. = NA (Gas) LEL: 10% UEL: 16.0% Flammable Gas, but only in presence of a high energy ignition source.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Carbon disulfide	75-15-0	TWA 1 ppm [skin]	TWA 1 ppm (3 mg/m3) ST 10 ppm (30 mg/m3) [skin]	TWA 20 ppm C 30 ppm 100 ppm (30-minute maximum peak)	500 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Dizziness, headache, poor sleep, lassitude (weakness, exhaustion), anxiety, anorexia, weight loss; psychosis; polyneuropathy; Parkinson-like syndrome; ocular changes; coronary heart disease; gastritis; kidney, liver injury; eye, skin burns; dermatitis; reproductive effects	Central nervous system, peripheral nervous system, cardiovascular system, eyes, kidneys, liver, skin, reproductive system	Colorless to faint-yellow liquid with a sweet ether-like odor. [Note: Reagent grades are foul smelling.] BP: 116°F Fl.Pt. = -22°F LEL: 1.3% UEL: 50.0% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.
Carbon tetrachloride	56-23-5	TWA 5 ppm STEL 10 ppm [skin]	Ca ST 2 ppm (12.6 mg/m3) [60-minute]	TWA 10 ppm C 25 ppm 200 ppm (5-minute maximum peak in any 4 hours)	Ca [200 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen]	Central nervous system, eyes, lungs, liver, kidneys, skin	Colorless liquid with a characteristic ether-like odor BP: 170°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Liquid
Chlorobenzene	108-90-7	TWA 10 ppm	NA	TWA 75 ppm (350 mg/m3)	1000 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose; drowsiness, incoordination; central nervous system depression; In Animals: liver, lung, kidney injury	Eyes, skin, respiratory system, central nervous system, liver	Colorless liquid with an almond-like odor BP: 270°F Fl.Pt. = 82°F LEL: 1.3% UEL: 9.6% Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F.
Chloroethane	75-00-3	TWA 100 ppm [skin]	Handle with caution in the workplace	TWA 1000 ppm (2600 mg/m3)	3800 ppm [10%LEL]	Inhalation, skin absorption (liquid), ingestion (liquid), skin and/or eye contact	Incoordination, inebriation; abdominal cramps; cardiac arrhythmias, cardiac arrest; liver, kidney damage	Liver, kidneys, respiratory system, cardiovascular system, central nervous system	Colorless gas or liquid (below 54°F) with a pungent, ether-like odor. [Note: Shipped as a liquefied compressed gas.] BP: 54°F Fl.Pt. = NA (gas), -58°F (liquid) LEL: 3.8% UEL: 15.4% Flammable Gas
Chloroform	67-66-3	TWA 10 ppm	Ca ST 2 ppm (9.78 mg/m3) [60-minute]	C 50 ppm (240 mg/m3)	Ca [500 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; dizziness, mental dullness, nausea, confusion; headache, lassitude (weakness, exhaustion); anesthesia; enlarged liver; [potential occupational carcinogen]	Liver, kidneys, heart, eyes, skin, central nervous system	Colorless liquid with a pleasant odor BP: 143°F Fl.Pt. = -82°F LEL: NA UEL: NA Noncombustible Liquid
Chloromethane	74-87-3	TWA 50 ppm STEL 100 ppm	Ca	TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 3 hours)	Ca [2000 ppm]	Inhalation, skin and/or eye contact (liquid)	Dizziness, nausea, vomiting; visual disturbance, stagger, slurred speech, convulsions, coma; liver, kidney damage; liquid: frostbite; reproductive, teratogenic effects; [potential occupational carcinogen]	Central nervous system, liver, kidneys, reproductive system	Colorless gas with a faint, sweet odor which is not noticeable at dangerous concentrations. [Note: Shipped as a liquefied compressed gas.] BP: -12°F Fl.Pt. = NA (Gas) LEL: 8.1% UEL: 17.4% Flammable Gas
cis-1,2-Dichloroethene	156-59-2	TWA 200 ppm (All isomers)	TWA 200 ppm (790 mg/m3)	TWA 200 ppm (790 mg/m3)	1000 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, respiratory system; central nervous system depression	Eyes, respiratory system, central nervous system	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor. BP: 118-140°F Fl.Pt. = 36-39°F LEL: 5.6% UEL: 12.8% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F
cis-1,3-Dichloropropene	10061-01-5	https://cameochemicals.noaa.gov/chemical/20168				Inhalation, ingestion, skin and/or eye contact	Symptoms of exposure to this compound may include local irritation of the eyes skin and respiratory tract; dermatitis, gasping, coughing, substernal pain, extreme respiratory distress, lacrimation, central nervous system depression, skin irritation, acute gastrointestinal distress with pulmonary congestion and edema. It also may cause injury to the liver, kidneys and heart.	Skin, eyes, mucous membranes, liver, kidney, heart	Colorless to amber liquid with a sweetish odor. BP: 219.7°F Fl.Pt. = NA LEL: NA UEL: NA
Cyclohexane	110-82-7	TWA 100 ppm	TWA 300 ppm (1050 mg/m3)	TWA 300 ppm (1050 mg/m3)	1300 ppm [10%LEL]	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system; drowsiness; dermatitis; narcosis, coma	Eyes, skin, respiratory system, central nervous system	Colorless liquid with a sweet, chloroform-like odor. [Note: A solid below 44°F.] BP: 177°F Fl.Pt. = 0°F LEL: 1.3% UEL: 8.0% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.
Dibromochloromethane	124-48-1	https://cameochemicals.noaa.gov/chemical/16183				Inhalation, ingestion, skin and/or eye contact	Symptoms of exposure to this compound may include irritation of the skin, eyes, mucous membranes and upper respiratory tract. It may also cause fatigue. Other symptoms may include central nervous system effects, lung and cornea irritation and liver and kidney damage. Prolonged exposure can cause nausea, dizziness, headache and narcosis.	Skin, eyes, mucous membranes, upper respiratory tract	Clear colorless to yellow-orange liquid BP: 246-248°F Fl.Pt. = Greater than 200°F LEL: NA UEL: NA

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Dichlorodifluoromethane	75-71-8	TWA 1000 ppm	TWA 1000 ppm (4950 mg/m3)	TWA 1000 ppm (4950 mg/m3)	15,000 ppm	Inhalation, skin and/or eye contact (liquid)	Dizziness, tremor, asphyxia, unconsciousness, cardiac arrhythmias, cardiac arrest; liquid: frostbite	Cardiovascular system, peripheral nervous system	Colorless gas with an ether-like odor at extremely high concentrations. [Note: Shipped as a liquefied compressed gas.] BP: -22°F Fl.Pt. = NA LEL: NA UEL: NA Nonflammable Gas
Ethyl benzene	100-41-4	TWA 20 ppm	TWA 100 ppm (435 mg/m^3) ST 125 ppm (545 mg/m^3)	TWA 100 ppm (435 mg/m^3)	800 ppm [10%LEL]	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eyes, skin, respiratory system, central nervous system	Colorless liquid with an aromatic odor. BP: 277°F Fl.Pt. = 55°F LEL: 0.8% UEL: 6.7% Class IB Flammable Liquid below 73°F and BP at or above 100°F
Isopropyl benzene	98-82-8	TWA 5 ppm	TWA 50 ppm (245 mg/m3) [skin]	TWA 50 ppm (245 mg/m3) [skin]	900 ppm [10%LEL]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; dermatitis; headache, narcosis, coma	Eyes, skin, respiratory system, central nervous system	Colorless liquid with a sharp, penetrating, aromatic odor BP: 306°F Fl.Pt. = 96°F LEL: 0.9% UEL: 6.5% Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F
Methyl Acetate	79-20-9	TWA 200 ppm STEL 250 ppm	TWA 200 ppm (610 mg/m3) ST 250 ppm (760 mg/m3)	TWA 200 ppm (610 mg/m3)	3100 ppm [10%LEL]	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; headache, drowsiness; optic nerve atrophy; chest tightness; In Animals: narcosis	Eyes, skin, respiratory system, central nervous system	Colorless liquid with a fragrant, fruity odor BP: 135°F Fl.Pt. = 14°F LEL: 3.1% UEL: 16% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.
Methylcyclohexane	108-87-2	TWA 400 ppm	TWA 400 ppm (1600 mg/m3)	TWA 500 ppm (2000 mg/m3)	1200 ppm [LEL]	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; dizziness, drowsiness; In Animals: narcosis	Eyes, skin, respiratory system, central nervous system	Colorless liquid with a faint, benzene-like odor BP: 214°F Fl.Pt. = 25°F LEL: 1.2% UEL: 6.7% Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.
Methylene chloride	75-09-2	TWA 50 ppm [skin] STEL 100 ppm	Ca	[1910.1052] TWA 25 ppm ST 125 ppm	Ca [2300 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numb, tingle limbs; nausea; [potential occupational carcinogen]	Eyes, skin, cardiovascular system, central nervous system	Colorless liquid with a chloroform-like odor. [Note: A gas above 104°F.] BP: 104°F Fl.Pt. = NA LEL: 13% UEL: 23% Combustible Liquid
Methyl-t-butyl ether	1634-04-4	TWA 50 ppm	NA	NA	NA	Inhalation, skin absorption, ingestion, skin and/or eye contact	May cause dizziness or suffocation. Contact may irritate or burn eyes or skin. May be harmful if swallowed.	Eyes, skin	A colorless liquid with a distinctive anesthetic-like odor. BP: 131°F Fl.Pt. = -14°F LEL: NA UEL: NA
o-Xylene	95-47-6	TWA 20 ppm (All isomers)	TWA 100 ppm (435 mg/m3) ST 150 ppm (655 mg/m3)	TWA 100 ppm (435 mg/m3)	900 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys	Colorless liquid with an aromatic odor BP: 292°F Fl.Pt. = 90°F LEL: 0.9% UEL: 6.7% Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F
Styrene	100-42-5	TWA 10 ppm STEL 20 ppm OTO (ototoxicant)	TWA 50 ppm (215 mg/m3) ST 100 ppm (425 mg/m3)	TWA 100 ppm C 200 ppm 600 ppm (5-minute maximum peak in any 3 hours)	700 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose, respiratory system; headache, lassitude (weakness, exhaustion), dizziness, confusion, malaise (vague feeling of discomfort), drowsiness, unsteady gait; narcosis; defatting dermatitis; possible liver injury; reproductive effects	Eyes, skin, respiratory system, central nervous system, liver, reproductive system	Colorless to yellow, oily liquid with a sweet, floral odor BP: 293°F Fl.Pt. = 88°F LEL: 0.9% UEL: 6.8% Class IC Flammable Liquid: Fl.P. at or above 73°F and below 100°F
Tetrachloroethene	127-18-4	TWA 25 ppm STEL 100 ppm	Ca Minimize workplace exposure concentrations	TWA 100 ppm C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm	Ca [150 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys, central nervous system	Colorless liquid with a mild, chloroform-like odor BP: 250°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Liquid, but decomposes in a fire to hydrogen chloride and phosgene

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Sodium Hydroxide	1310-73-2	Ceiling 2 mg/m^3	C 2 mg/m^3	TWA 2 mg/m^3	10 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; pneumonitis; eye, skin burns; temporary loss of hair	Eyes, skin, respiratory system	Colorless to white, odorless solid (flakes, beads, granular form). BP: 2534°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Solid, but when in contact with water may generate sufficient heat to ignite combustible materials.
Sulfuric Acid	7664-93-9	TWA 0.2 mg/m^3 (as thoracic particulate mass)	TWA 1 mg/m^3	TWA 1 mg/m^3	15 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; pulmonary edema, bronchitis; emphysema; conjunctivitis; stomatis; dental erosion; eye, skin burns; dermatitis	Eyes, skin, respiratory system, teeth	Colorless to dark-brown, oily, odorless liquid.[Note: Pure compound is a solid below 51°F. Often used in an aqueous solution.] BP = 554°F Fl.Pt. = NA LEL = NA UEL = NA Noncombustible Liquid, but capable of igniting finely divided combustible materials.
trans-1,2-Dichloroethene	156-60-5	200 ppm (All isomers)	TWA 200 ppm (790 mg/m3)	TWA 200 ppm (790 mg/m3)	1000 ppm	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, respiratory system; central nervous system depression	Eyes, respiratory system, central nervous system	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor. BP: 118-140°F Fl.P: 36-39°F LEL: 5.6% UEL: 12.8% Class IB Flammable Liquid Fl.P. below 73°F and BP at or above 100°F.
trans-1,3-Dichloropropene	10061-02-6	https://cameochemicals.noaa.gov/chemical/18110				Inhalation, ingestion, skin and/or eye contact	Symptoms of exposure to this compound may include local irritation of the eyes skin and respiratory tract, dermatitis, gasping, coughing, substernal pain, extreme respiratory distress, lacrimation, central nervous system depression, acute gastrointestinal distress with pulmonary congestion and edema. It may also cause injury to the liver, kidneys and heart	Skin, eyes, mucous membranes, liver, kidney, heart	A clear colorless liquid with chloroform odor BP: 234°F Fl.P: NA LEL: NA UEL: NA
Toluene	108-88-3	TWA 20 ppm (ototoxicant)	TWA 100 ppm (375 mg/m^3) ST 150 ppm (560 mg/m^3)	TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak)	500 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Colorless liquid with a sweet, pungent, benzene-like odor. BP: 232°F Fl.P: 40°F LEL: 1.1% UEL: 7.1% Class IB Flammable Liquid Fl.P. below 73°F and BP at or above 100°F.
Trichloroethene (TCE)	79-01-6	TWA 10 ppm STEL 25 ppm	Ca	TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)	Ca [1000 ppm]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system	Colorless liquid (unless dyed blue) with a chloroform-like odor. BP: 189°F Fl.Pt. = NA LEL(77°F): 8.0% UEL(77°F): 10.5% Combustible Liquid, but burns with difficulty.
Trichlorofluoromethane	75-69-4	STEL C 1000 ppm	C 1000 ppm (5600 mg/m3)	TWA 1000 ppm (5600 mg/m3)	2000 ppm	Inhalation, ingestion, skin and/or eye contact	Incoordination, tremor; dermatitis; cardiac arrhythmias, cardiac arrest; asphyxia; liquid: frostbite	Skin, respiratory system, cardiovascular system	Colorless to water-white, nearly odorless liquid or gas (above 75°F) BP: 75°F Fl.P: NA LEL: NA UEL: NA Noncombustible Liquid Nonflammable Gas
Vinyl Chloride (chloroethylene)	75-01-4	TWA 1 ppm	Ca	TWA 1 ppm C 5 ppm [15-minute]	Ca (ND)	Inhalation, skin and/or eye contact (liquid)	Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]	Liver, central nervous system, blood, respiratory system, lymphatic system	Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations.[Note: Shipped as a liquefied compressed gas.] BP: 7°F Fl.Pt. = NA (Gas) LEL: 3.6% UEL: 33.0% Flammable Gas
Xylene (m, o & p isomers)	108-38-3, 95-47-6, 106-42-3	TWA 20 ppm	NA	NA	NA	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys	Colorless liquid with an aromatic odor BP: 282°F, 292°F, 281°F Fl. Pt. 82°F, 90°F, 81°F LEL: 1.1%, 0.9%, 1.1% UEL: 7.0%, 6.7%, 7.0% Class IC Flammable Liquid at or above 73°F and below 100°F.
Zinc Oxide (dust)	7440-66-6	TWA 2 mg/m3 (repsirable) STEL 10 mg/m^3 (respirable)	TWA 5 mg/m^3 C 15 mg/m^3	TWA 15 mg/m^3 (total dust) TWA 5 mg/m^3 (resp dust) TWA 5 mg/m^3 (fume)	500 mg/m^3	Inhalation	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function	Respiratory system	White, odorless solid. BP: NA Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Solid

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
SEMI-VOLATILE ORGANIC COMPOUNDS (SVOCs)									
2-Chloronaphthalene	91-58-7	https://cameochemicals.noaa.gov/chemical/16185				Inhalation, ingestion, skin and/or eye contact	Chloracne, cysts, headache, fatigue, vertigo, anorexia and jaundice		Monoclinic plates or off-white crystalline powder BP: NA Fl.Pt. = NA LEL: NA UEL: NA
2-Methylnaphthalene	91-57-6	TWA 0.5 ppm TLV-SL 3 mg/100 cm2 [skin]	https://cameochemicals.noaa.gov/chemical/20668			Inhalation, ingestion, skin and/or eye contact	Headaches, nausea, vomiting, diarrhea, anemia, jaundice, euphoria, dermatitis, visual disturbances, convulsions and comatose	Skin, eyes, mucous membranes and upper respiratory tract	White crystalline solid Combustible solid BP: 466-468 ° F Fl.Pt. = 208 ° F LEL: NA UEL: NA
Acenaphthene	83-32-9	https://cameochemicals.noaa.gov/chemical/10358				Inhalation, ingestion, skin and/or eye contact	Irritation of the skin, eyes, mucous membranes and upper respiratory tract, vomiting	Skin, eyes, mucous membranes and upper respiratory tract	White needles BP: 534 ° F Fl.Pt. = NA LEL: 0.6% UEL: NA
Acenaphthylene	208-96-8	https://cameochemicals.noaa.gov/chemical/16157				Inhalation, ingestion, skin and/or eye contact			Colorless crystalline solid BP: 509 to 527 ° F at 760 mm Hg Fl.Pt. = NA LEL: NA UEL: NA
Anthracene (as coal tar pitch volatiles)	120-12-7	TWA 0.2 mg/m3 (as Benzene solubles)	Ca TWA 0.1 mg/m3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m3 (benzene-soluble fraction) [1910.1002]	Ca [80 mg/m3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	Respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue BP: NA Fl.Pt. = NA LEL: NA UEL: NA Combustible Solids
Benzo[a]anthracene	56-55-3	https://cameochemicals.noaa.gov/chemical/16171				Inhalation, injestion, skin and/or eye contact			Colorless leaflets or plates or coarse gold powder with a greenish-yellow fluorescence. May reasonably be expected to be a carcinogen. BP: 815° F at 760 mm Hg Fl.Pt. = NA LEL: NA UEL: NA
Benzo[a]pyrene (as coal tar pitch volatiles)	50-32-8	TWA 0.2 mg/m3 (as Benzene solubles)	Ca TWA 0.1 mg/m3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m3 (benzene-soluble fraction) [1910.1002]	Ca [80 mg/m3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	Respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue BP: NA Fl.Pt. = NA LEL: NA UEL: NA Combustible Solids
Benzo[b]fluoranthene	205-99-2	None listed	https://cameochemicals.noaa.gov/chemical/16172			Inhalation, injestion, skin and/or eye contact			Needles or yellow fluffy powder BP: NA Fl.Pt. = NA LEL: NA UEL: NA
Benzo[g,h,i]perylene	191-24-2	https://cameochemicals.noaa.gov/chemical/16174				Inhalation, injestion, skin and/or eye contact	Inhalation of material may be harmful. Contact may cause burns to skin and eyes. Inhalation of Asbestos dust may have a damaging effect on the lungs. Fire may produce irritating, corrosive and/or toxic gases. Some liquids produce vapors that may cause dizziness or suffocation. Runoff from fire control may cause pollution.	Lungs, skin, eyes	Colorless to white crystalline solid. Water insoluble. BP: NA Fl.Pt. = NA LEL: NA UEL: NA
Benzo[k]fluoranthene	207-08-9	https://cameochemicals.noaa.gov/chemical/16173				Inhalation, injestion, skin and/or eye contact	When heated to decomposition this compound emits acrid smoke and irritating fumes.		Pale yellow needles or yellow crystalline solid BP: 896° F Fl.Pt. = NA LEL: NA UEL: NA
Chrysene (as coal tar pitch volatiles	218-01-9	TWA 0.2 mg/m3 (as Benzene solubles)	Ca TWA 0.1 mg/m3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m3 (benzene-soluble fraction) [1910.1002]	Ca [80 mg/m3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	Respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue BP: NA Fl.Pt. = NA LEL: NA UEL: NA Combustible Solids
Dibenzo(a,h)anthracene	53-70-3	https://cameochemicals.noaa.gov/chemical/16192				Inhalation, injestion, skin and/or eye contact	Symptoms of exposure to this compound may include irritation. This compound is harmful if swallowed or inhaled. It may cause irritation. When heated to decomposition it emits acrid smoke, irritating fumes and toxic fumes of carbon monoxide and carbon dioxide.	Lungs	White crystals or pale yellow solid. Sublimes BP: 975° F Fl.Pt. = NA LEL: NA UEL: NA

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Fluoranthene	206-44-0	https://cameochemicals.noaa.gov/chemical/16213				Inhalation, injestion, skin and/or eye contact	When heated to decomposition this compound emits acrid smoke and fumes.		Light yellow fine crystals BP: 482° F Fl.Pt. = NA LEL: NA UEL: NA
Fluorene	86-73-7	https://cameochemicals.noaa.gov/chemical/16214				Inhalation, injestion, skin and/or eye contact			White leaflets. Sublimes easily under a vacuum. Fluorescent when impure. BP: 563° F Fl.Pt. = NA LEL: NA UEL: NA
Indeno[1,2,3-cd]pyrene	193-39-5	https://cameochemicals.noaa.gov/chemical/16218				Inhalation, injestion, skin and/or eye contact			Yellow crystals BP: 997° F Fl.Pt. = NA LEL: NA UEL: NA
Naphthalene	91-20-3	TWA 10 ppm [skin]	TWA 10 ppm (50 mg/m3) ST 15 ppm (75 mg/m3)	TWA 10 ppm (50 mg/m3)	250 ppm	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage	Eyes, skin, blood, liver, kidneys, central nervous system	Colorless to brown solid with an odor of mothballs. [Note: Shipped as a molten solid.] BP: 424°F Fl.P: 174°F LEL: 0.9% UEL: 5.9% Combustible Solid, but will take some effort to ignite
Phenanthrene	85-01-8	https://cameochemicals.noaa.gov/chemical/16236				Inhalation, injestion, skin and/or eye contact	Symptoms following exposure to this compound may include skin sensitization, dermatitis, bronchitis, cough, dyspnea, respiratory neoplasm, kidney neoplasm, skin irritation, and respiratory irritation.	Skin, respiratory tract	Colorless monoclinic crystals with a faint aromatic odor. Solutions exhibit a blue fluorescence. BP: 642° F Fl.Pt. = 340° F LEL: NA UEL: NA
Pyrene (see coal tar pitch volatiles)	129-00-0	TWA 0.2 mg/m3 (as Benzene solubles)	Ca TWA 0.1 mg/m3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m3 (benzene-soluble fraction) [1910.1002]	Ca [80 mg/m3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	Respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue BP: NA Fl.Pt. = NA LEL: NA UEL: NA Combustible Solids
METALS									
Aluminum	7429-90-5	TWA 1 mg/m3	TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (resp)	TWA 15 mg/m^3 (total) TWA 5 mg/m^3 (resp)	N.D.	Inhalation, skin and/or eye contact	Irritation eyes, skin, respiratory system	Eyes, skin, respiratory system	Silvery-white, malleable, ductile, odorless metal BP: 4221°F Fl.Pt. = NA LEL: NA UEL: NA Combustible Solid, finely divided dust is easily ignited; may cause explosions.
Antimony	7440-36-0	TWA 0.5 mg/m3 (as Sb)	TWA 0.5 mg/m3 [*Note: The REL also applies to other antimony compounds (as Sb).]	TWA 0.5 mg/m3 [*Note: The PEL also applies to other antimony compounds (as Sb).]	50 mg/m3 (as Sb)	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, mouth; cough; dizziness; headache; nausea, vomiting, diarrhea; stomach cramps; insomnia; anorexia; unable to smell properly	Eyes, skin, respiratory system, cardiovascular system	Silver-white, lustrous, hard, brittle solid; scale-like crystals; or a dark-gray, lustrous powder BP: 2975°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Solid in bulk form, but a moderate explosion hazard in the form of dust when exposed to flame.
Arsenic	7440-38-2	TWA 0.01 mg/m3	Ca C 0.002 mg/m3 [15-minute]	[1910.1018] TWA 0.010 mg/m3	Ca [5 mg/m3 (as As)]	Inhalation, skin absorption, skin and/or eye contact, ingestion	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, resp irritation, hyperpigmentation of skin, [potential occupational carcinogen]	Liver, kidneys, skin, lungs, lymphatic system	Metal: Silver-gray or tin-white, brittle, odorless solid BP: Sublimes Fl.Pt. = NA LEL: NA UEL: NA Metal: Noncombustible Solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame
Barium	7440-39-3	TWA 0.5 mg/m3	0.5 mg Ba/m3 TWA	0.5 mg Ba/m3 TWA	50 mg Ba/m3	Inhalation, ingestion, skin and/or eye contact	Inhalation or contact with vapors, substance or decomposition products may cause severe injury or death. Contact may cause burns to skin, eyes, and mucous membranes. May be toxic by ingestion, inhalation and skin absorption. Used to make other chemicals.	Lungs, skin, eyes, and mucous membrane	A silver to white metallic solid BP: 1337°F Fl.Pt. = NA LEL: NA UEL: NA
Beryllium	7440-41-7	TWA 0.00005 mg/m^3	Ca C 0.0005 mg/m^3	TWA 0.002 mg/m^3 C 0.005 mg/m^3 0.025 mg/m3 [30-minute maximum peak]	Ca [4 mg/m^3 (as Be)]	Inhalation, skin and/or eye contact	Berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis; [potential occupational carcinogen]	Eyes, skin, respiratory system	Hard, brittle, gray-white solid BP: 4532°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Solid in bulk form, but a slight explosion hazard in the form of a powder or dust.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Cadmium	7440-43-9	TWA 0.01 mg/m^3 total dust TWA 0.002 mg/m^3 (as Cd) respirable fraction	Ca	TWA 0.005 mg/m^3	Ca [9 mg/m3 (as Cd)]	Inhalation, ingestion	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	Respiratory system, kidneys, prostate, blood	Silver-white/blue tinged lustrous, odorless solid. BP: 1409°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible - will burn in powder form
Calcium	7440-70-2	https://cameochemicals.noaa.gov/chemical/309				Inhalation, ingestion, skin and/or eye contact	Contact with eyes or skin produces caustic burns.	Eyes, skin	A silvery, soft metal that turns grayish white on exposure to air. BP: 2714°F Fl.Pt. = NA LEL: NA UEL: NA
Chromium	7440-47-3	TWA 0.5 mg/m^3 (metal) TWA 0.003 mg/m^3 (water-soluble Cr III compounds) TWA 0.0002 mg/m^3 (water-soluble Cr VI compounds) STEL 0.0005 mg/m3 (water-soluble Cr VI compounds)	TWA 0.5 mg/m^3	TWA 1 mg/m^3	250 mg/m^3 (as Cr)	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; lung fibrosis (histologic)	Eyes, skin, respiratory system	Blue-white to steel-gray, lustrous, brittle, hard, odorless solid. BP: 4788°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible - will burn in dust form if heated in a flame
Cobalt	7440-48-4	TWA 0.02 mg/m3 [DSEN] [RSEN]	TWA 0.05 mg/m3	TWA 0.1 mg/m3	20 mg/m3 (as Co)	Inhalation, ingestion, skin and/or eye contact	Cough, dyspnea (breathing difficulty), wheezing, decreased pulmonary function; weight loss; dermatitis; diffuse nodular fibrosis; resp hypersensitivity, asthma	Skin, respiratory system	Odorless, silver-gray to black solid BP: 5612°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Solid in bulk form, but finely divided dust will burn at high temperatures.
Copper	7440-50-8	TWA 0.2 mg/m^3 (fume) TWA 1 mg/m3 (dusts and mists)	TWA 1 mg/m^3	TWA 1 mg/m^3	100 mg/m^3 (as Cu)	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis; In Animals: lung, liver, kidney damage; anemia	Eyes, skin, respiratory system, liver, kidneys (increased risk with Wilson's disease)	Reddish, lustrous, malleable, odorless solid. BP: 4703°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible - powdered form may ignite
Iron (as iron oxide)	7439-89-6	TWA 5 mg/m3 (respirable particulate mass)	TWA 1 mg/m^3	NA	NA	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; abdominal pain, diarrhea, vomiting; possible liver damage	Eyes, skin, respiratory system, liver, gastrointestinal tract	Appearance and odor vary depending upon the specific soluble iron salt. BP: NA Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Solids
Lead	7439-92-1	TWA 0.05 mg/m3	TWA (8-hour) 0.050 mg/m3	[1910.1025] TWA 0.050 mg/m3	100 mg/m3 (as Pb)	Inhalation, ingestion, skin and/or eye contact	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension	Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue	A heavy, ductile, soft, gray solid BP: 3164°F Fl.Pt. = NA LEL: NA UEL: NA Noncombustible Solid in bulk form
Magnesium	7439-95-4	https://cameochemicals.noaa.gov/chemical/6949				Eye and/or skin contact	Dust irritates eyes in same way as any foreign material. Penetration of skin by fragments of metal is likely to produce local irritation, blisters, and ulcers which may become infected.	Eyes	A light silvery metal BP: 1202°F Fl.Pt. = NA LEL: NA UEL: NA
Manganese	7439-96-5	TWA 0.02 mg/m3 [R] TWA 0.1 mg/m3 [I]	TWA 1 mg/m3 ST 3 mg/m3	C 5 mg/m3	500 mg/m3 (as Mn)	inhalation, ingestion	Manganism; asthenia, insomnia, mental confusion; metal fume fever: dry throat, cough, chest tightness, dyspnea (breathing difficulty), rales, flu-like fever; low-back pain; vomiting; malaise (vague feeling of discomfort); lassitude (weakness, exhaustion); kidney damage	respiratory system, central nervous system, blood, kidneys	A lustrous, brittle, silvery solid BP: 3564°F Fl.Pt. = NA LEL: NA UEL: NA Metal: Combustible Solid
Mercury	7439-97-6	TWA 0.1 mg/m3, as Hg Aryl compounds TWA 0.025 mg/m3 as Hg, inorganic forms including metallic mercury	Hg Vapor: TWA 0.05 mg/m3 [skin] Other: C 0.1 mg/m3 [skin]	TWA 0.1 mg/m3	10 mg/m3 (as Hg)	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eyes, skin, respiratory system, central nervous system, kidneys	Metal: Silver-white, heavy, odorless liquid. [Note: "Other" Hg compounds include all inorganic & aryl Hg compounds except (organo) alkyls.] BP: 674°F Fl.Pt. = NA LEL: NA UEL: NA Metal: Noncombustible Liquid

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Nickel	7440-02-0	TWA 1.5 mg/m^3 [elemental] TWA 0.1 mg/m^3 [soluble inorganic compound] TWA 0.2 mg/m^3 [insoluble inorganic compound] TWA 0.1 mg/m^3 [Nickel subsulfide]	Ca TWA 0.015 mg/m^3	TWA 1 mg/m^3	Ca [10 mg/m3 (as Ni)]	Inhalation, ingestion, skin and/or eye contact	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]	Nasal cavities, lungs, skin	Lustrous, silvery, odorless solid. BP: 5139°F Fl.Pt. = NA LEL: NA UEL: NA Combustible Solid; nickel sponge catalyst may ignite spontaneously in air.
Potassium	9/7/7440	https://cameochemicals.noaa.gov/chemical/4289				Eye and/or skin contact	Will burn skin and eyes	Skin, eyes	Potassium is a soft silvery metal though normally grayish white due to oxidation BP: 1425°F Fl.Pt. = NA LEL: NA UEL: NA
Selenium	7782-49-2	TWA 0.2 mg/m3	TWA 0.2 mg/m3	TWA 0.2 mg/m3	1 mg/m3 (as Se)	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breath, gastrointestinal disturbance; dermatitis; eye, skin burns; In Animals: anemia; liver necrosis, cirrhosis; kidney, spleen damage	Eyes, skin, respiratory system, liver, kidneys, blood, spleen	Amorphous or crystalline, red to gray solid. [Note: Occurs as an impurity in most sulfide ores.] BP: 1265°F Fl.Pt. = NA LEL: NA UEL: NA Combustible Solid
Silver	7440-22-4	TWA 0.1 mg/m3 [Metal, dust, and fume] TWA 0.01 mg/m3 [Soluble compounds, as Ag]	TWA 0.01 mg/m3	TWA 0.01 mg/m3	10 mg/m3 (as Ag)	Inhalation, ingestion, skin and/or eye contact	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Nasal septum, skin, eyes	Metal: White, lustrous solid BP: 3632°F Fl.Pt. = NA LEL: NA UEL: NA Metal: Noncombustible Solid, but flammable in form of dust or powder
Sodium	7440-23-5	https://cameochemicals.noaa.gov/chemical/7794				Skin contact	Severe burns caused by burning metal or by caustic soda formed by reaction with moisture on skin	Skin	A silvery soft metal that becomes grayish white upon exposure to air BP: 1621°F Fl.Pt. = NA LEL: NA UEL: NA
Thallium	7440-28-0	0.02 mg/m3 inhallable particulate matter	TWA 0.1 mg/m3 [skin]	TWA 0.1 mg/m3 [skin]	15 mg/m3 (as Tl)	Inhalation, skin absorption, ingestion, skin and/or eye contact	Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs	Eyes, respiratory system, central nervous system, liver, kidneys, gastrointestinal tract, body hair	Appearance and odor vary depending upon the specific soluble thallium compound BP: NA Fl.Pt. = NA LEL: NA UEL: NA
Vanadium	7440-62-2	https://cameochemicals.noaa.gov/chemical/16147				Inhalation, skin absorption, ingestion, skin and/or eye contact	Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin. Avoid any skin contact. Effects of contact or inhalation may be delayed. Fire may produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution	Skin	Silvery-whitish powder BP: NA Fl.Pt. = NA LEL: NA UEL: NA
Zinc	7440-66-6	https://cameochemicals.noaa.gov/chemical/4814				Inhalation, skin absorption, ingestion, skin and/or eye contact	Inhalation or contact with vapors, substance or decomposition products may cause severe injury or death. May produce corrosive solutions on contact with water. Fire will produce irritating, corrosive and/or toxic gases. Runoff from fire control may cause pollution	Lungs	A grayish powder BP: NA Fl.Pt. = NA LEL: NA UEL: NA
PCBs									
PCBs (total)	11097-69-1, 53469-21-9	TWA 0.5 mg/m3 [skin] TWA 1 mg/m3 [skin]	Ca TWA 0.001 mg/m3 Ca TWA 0.001 mg/m3	TWA 0.5 mg/m3 [skin] TWA 1 mg/m3 [skin]	Ca [5 mg/m3] Ca [5 mg/m3]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, chloracne; liver damage; reproductive effects; [potential occupational carcinogen]	Skin, eyes, liver, reproductive system	Colorless to pale-yellow, viscous liquid or solid (below 50°F) with a mild, hydrocarbon odor BP: 689-734°F, 617-691°F Fl.Pt. = NA, NA LEL: NA UEL: NA Nonflammable Liquid, but exposure in a fire results in the formation of a black soot containing PCBs, polychlorinated dibenzofurans, and chlorinated dibenzo-p-dioxins.
Petroleum Hydrocarbons									
Gasoline	86290-81-5	TWA 300 ppm STEL 500 ppm	Ca	None	Ca [N.D.]	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; dermatitis; headache, lassitude (weakness, exhaustion), blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis (aspiration liquid); possible liver, kidney damage; [potential occupational carcinogen]	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Clear liquid with a characteristic odor BP: 102°F Fl.Pt. = -45°F LEL: 1.4% UEL: 7.6%

References
Centers for Disease Control and Prevention, 2018. *NIOSH Pocket Guide to Chemical Hazards.* The National Institute for Occupational Safety and Health.
American Conference of Governmental Industrial Hygienists (ACGIH), 2017. *2017 TLVs® and BEIs®.* Cincinnati, OH.
National Oceanic and Atmospheric Administration (NOAA) and Environmental Protection Agency (EPA), 2019. *CAMEO Chemicals Database* . https://cameochemicals.noaa.gov/
U.S. Department of Labor, 1990. *OSHA Regulated Hazardous Substances.* Industrial Exposure and Control Technologies Government Institutes, Inc.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at 280 Bergen Street, Brooklyn, NY.

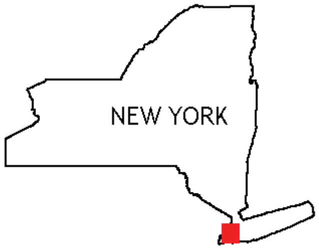
Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties

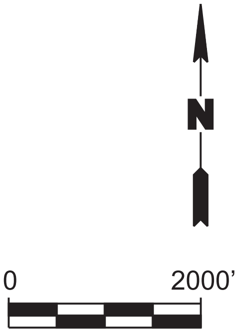
Sax, N. Van Nostrand and Reinhold Company, 1987. *Hawley's Condensed Chemical Dictionary, 11th Edition.*
Proctor, N.H., J.P. Hughes and M.L. Fischman, 1989. *Chemical Hazards of the Workplace* . Van Nostrand Reinhold. New York.
Sax, N.I. and R.J. Lewis, 1989. *Dangerous Properties of Industrial Materials, 7th Edition.* Van Nostrand Reinhold. New York.

Abbreviations:
ACGIH – American Conference of Governmental Industrial Hygienists.
BP – boiling point at 1 atmosphere, °F
C – Ceiling, is a concentration that should not be exceeded during and part of the working exposure.
Ca – Carcinogenic.
CAS# - Chemical Abstracts Service registry number which is unique for each chemical.
DSEN - Dermal Sensitization
Ft Pt. – Flash point
IDLH - Immediately Dangerous to Life and Health concentrations represent the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
LEL – Lower explosive (flammable) limit in air, % by volume (at room temperature)
mg/m^3 – Milligrams of substance per cubic meter of air
NIOSH - National Institute for Occupational Safety and Health.
OSHA – Occupational Safety and Health Administration
OTO - Ototoxicant
PEL - OSHA Permissible Exposure Limit (usually) a time weighted average concentration that must not be exceeded during any 8 hour work shift of a 40 hr work week.
ppm – parts per million
REL – NIOSH Recommended Limit indicated a time weighted average concentration that must not be exceeded during any 10 hour work shift of a 40 hr work week
RSEN - Respiratory Sensitization
SG - Specific Gravity
STEL – ACGIH Short-term exposure limit (ST)
TLV - ACGIH Threshold Limit Values (usually 8 hour time weighted average concentrations).
TWA – 8-hour, time-weighted average
UEL – Upper explosive (flammable) limit in air, % by volume (at room temperature)
VP - Vapor Pressure

FIGURES

QUADRANGLE LOCATION





SOURCE:
USGS; 2019, Brooklyn, NY
7.5 Minute Topographic Quadrangle

\4442Y0001Y\105\4442.0001Y105.01.CDR

Title:

SITE LOCATION MAP

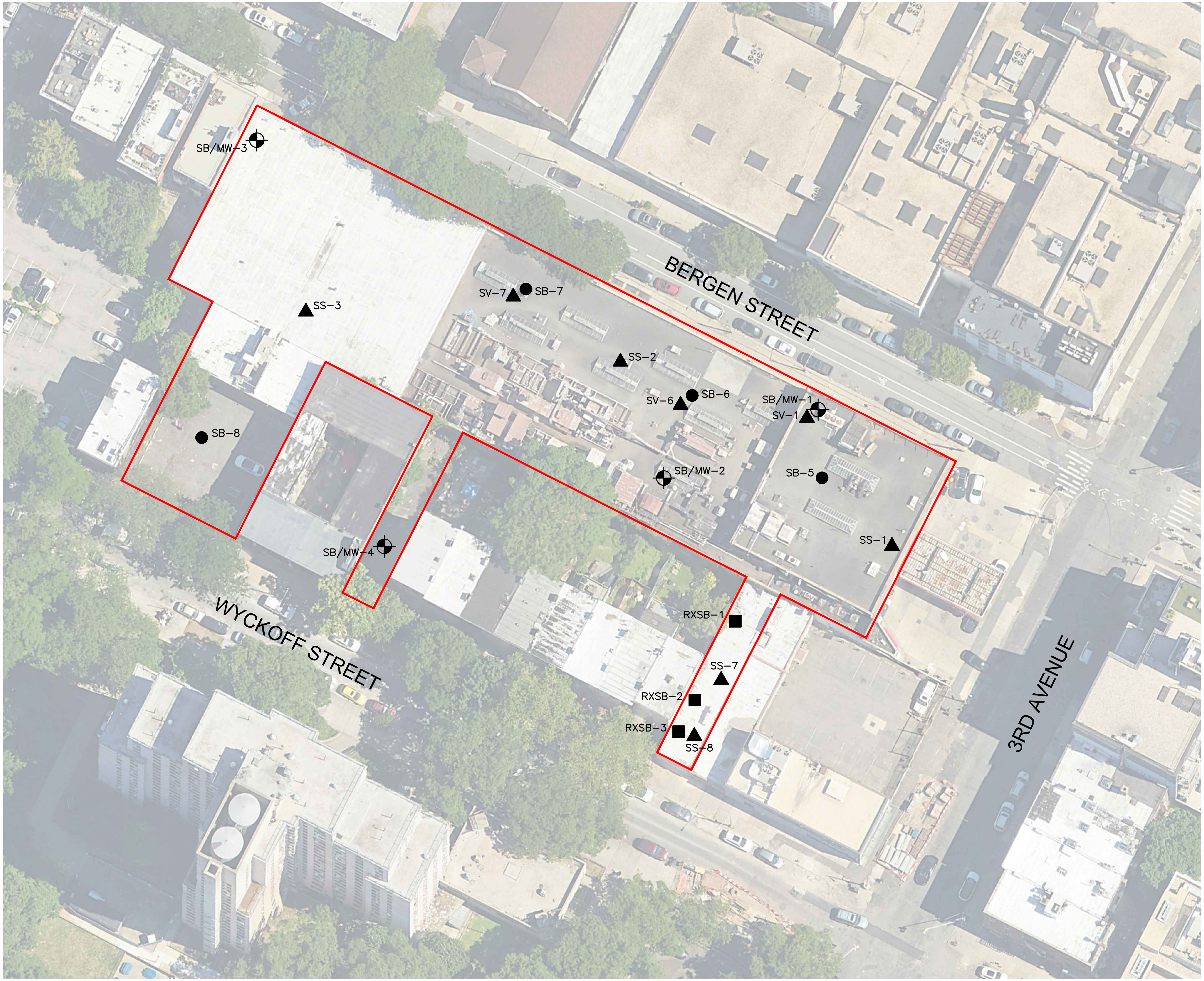
280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 17OCT23	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	1
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y105.01.CDR		



LEGEND

🟥	APPROXIMATE SITE BOUNDARY
SB/MW–1 ⊕	GROUNDWATER AND SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SB–6 ●	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
SV–6 ▲	SOIL VAPOR SAMPLE LOCATION AND DESIGNATION (COLLECTED BY VHB)
RXSB–1 ■	SOIL SAMPLE LOCATION AND DESIGNATION (COLLECTED BY ROUX)

N

50' 0 50'

Title:

SITE PLAN
AND SAMPLE LOCATIONS

280 BERGEN ST., 265 WYCKOFF ST., 287 WYCOFF ST.
BROOKLYN, NEW YORK

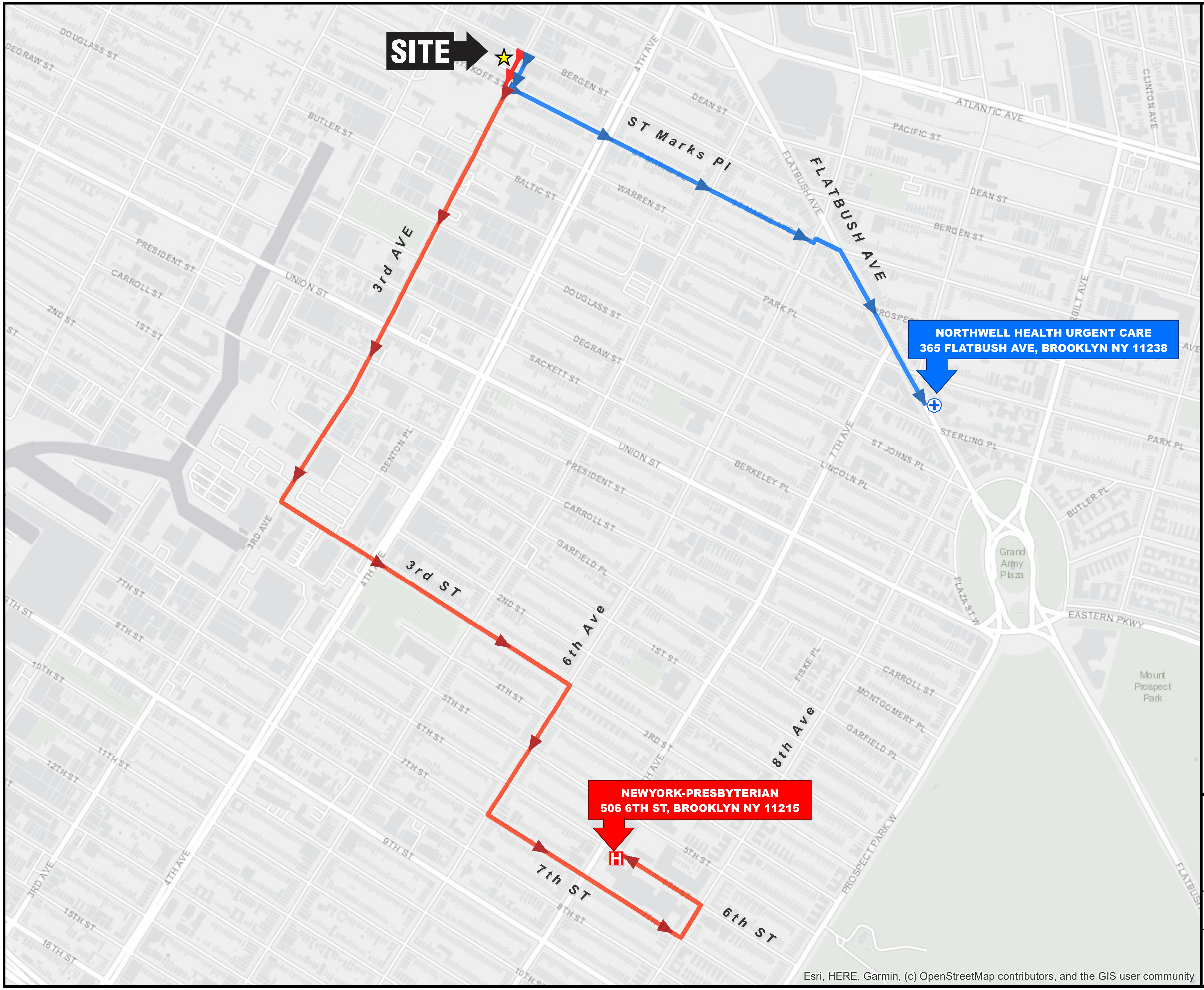
Prepared for:

BERGEN ST EQUITY LLC

ROUX

Compiled by: R.K.	Date: 10/18/2023	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	2
Project Mgr: R.K.	Project: 4442.0001Y000	
File: 4442.0001Y105.02.DWG		

V:\CAD\PROJECTS\4442Y\0001Y\105\4442.0001Y105.02.DWG BCICIO



Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N

DIRECTIONS TO HOSPITAL ←

1. HEAD SOUTHEAST TOWARD 3RD AVE
2. TURN RIGHT ONTO 3RD AVE
3. TURN LEFT ONTO 3RD ST
4. TURN RIGHT ONTO 6TH AVE
5. TURN LEFT ONTO 7TH ST
6. TURN LEFT ONTO 8TH AVE
7. TURN LEFT ONTO 6TH ST
8. DESTINATION WILL BE ON THE LEFT

DIRECTIONS TO URGENT CARE →

1. HEAD SOUTHEAST TOWARD 3RD AVE
2. TURN RIGHT ONTO 3RD AVE
3. TURN LEFT ONTO ST MARKS PL
4. TURN LEFT ONTO 6TH AVE
5. TURN RIGHT ONTO FLATBUSH AVE
6. DESTINATION WILL BE ON THE LEFT

650 0 650
Feet

Title:

ROUTES TO URGENT CARE AND HOSPITAL

280 BERGEN STREET, BROOKLYN, NEW YORK

Prepared for:

BERGEN ST EQUITY, LLC

ROUX

		FIGURE
Compiled by: J.M.	Date: 10/19/23	3
Prepared by: M.S.R.	Scale: AS SHOWN	
Project Mgr: J.M.	Project: 4442.0001Y000	
File: 4442.0001Y105.3.mxd		

V:\GIS\Projects\4442\0001Y\105\4442.0001Y105.3.mxd

APPENDICES

A. Professional Profiles
B. Job Safety Analysis (JSA) Forms
C. Safety Data Sheets (SDSs) for Chemicals Used
D. COVID-19 Interim Health and Safety Guidance
E. Heat Illness Prevention Program
F. Personal Protective Equipment (PPE) Management Program
G. Heavy Equipment Exclusion Zone Policy
H. Subsurface Utility Clearance Management Program
I. Incident Investigation and Reporting Management Program

APPENDIX A

Professional Profiles

PROFESSIONAL PROFILE

Robert Kovacs, LSRP, PG

Principal Scientist

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Website: www.rouxinc.com

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Islandia, NY 11749

EDUCATION

BA, Biological Sciences, University of Delaware, Newark, Delaware, 1999.

PROFESSIONAL LICENSES

Licensed Site Remediation Professional, New Jersey (License No. 627589)

New York State Professional Geologist (License No.000437)

NJDEP UST Certification Program-Subsurface Evaluator (License No. 239024)

EXPERIENCE SUMMARY

Twenty-three years of experience: Principal, Senior, Project, Staff and Staff Assistant Environmental Scientist at Roux, Islandia, New York.

TECHNICAL SPECIALTIES

Design, implementation and management of Environmental Site Assessments, Remedial Investigations, Remedial Actions, and Construction Support at Transportation, Industrial, and Brownfield Redevelopment sites; Development of regulatory strategy and regulatory agency negotiations; Characterization and decommissioning of industrial manufacturing facilities; Roux Corporate QA/QC Officer.

REPRESENTATIVE PROJECTS

- **Amtrak Sunnyside Yard State Superfund Site, Queens, New York.** Principal-in-Charge for multiple projects to support investigation and remediation activities at this State Superfund site. Mr. Kovacs was responsible for overseeing activities in all six Operable Units (OUs), including unsaturated and saturated soil, groundwater, separate-phase hydrocarbon, soil vapor and on-site sewer system. His responsibilities on these projects included PFAS investigations; UST removals; characterizing subsurface conditions, including soil (collected hundreds of soil samples to characterize the 130+ acre active railyard), as well as characterizing a 250,000-gallon PCB-contaminated separate-phase hydrocarbon plume. Additionally, he was responsible for overseeing the design and implementation of remediation activities, including soil excavation and offsite disposal, removal and abandonment of USTs ranging in sizes up to 17,000 gallons, demolition of contaminated buildings and infrastructure, and installation and operation of a dual phase high vacuum extraction (DPVE) system to recover PCB-contaminated separate-phase hydrocarbon through a network of over 40 recovery wells. Due to the highly volatile nature of the separate-phase hydrocarbon and the urban setting of this site, extensive emissions and odor engineering controls were used when excavating and managing soil and product. Additionally, extensive Community Air Monitoring was completed during all phases of work. Mr. Kovacs was also responsible for interaction with all regulatory agencies, as well as preparing and/or reviewing all major project reports and deliverables.

- **Amtrak Infrastructure Construction Projects.** Principal-in-Charge of several large infrastructure upgrade projects for Amtrak, including the Next Generation Acela Ready Track project, the Sunnyside Yard Security Enhancement project, the Sunnyside Yard Water Main Upgrade project, and the initial stages of the Intercity Trainset (ICT) project. Mr. Kovacs is serving as Project Principal, and involved in the planning, site characterization (including PFAS evaluations), construction oversight, and regulatory agency coordination associated with these projects.

- **Pharmaceutical Manufacturing Facility, Brooklyn, New York.** Project Manager/Project Principal for environmental work associated with the seven-block former manufacturing plant. This Site included a former 700,000 square foot manufacturing plant, as well as several other former industrial facilities with operations starting as far back as the 1850's. Responsibilities included UST removals; the design and completion of multiple phases of subsurface investigations to characterize soil and groundwater quality, as well as soil vapor. Contaminants included hydrocarbons, benzene, PCBs, and heavy metals, including lead, mercury, and arsenic. Work included development and preparation of investigation and remediation work plans, coordination and management of field investigations, including the installation of shallow and deep monitoring wells and soil borings using sonic drilling methods, completion of a geophysical survey, collection of groundwater samples, and management of remediation activities. Remediation activities included soil excavation, UST removals, and the installation of a soil vapor extraction and air sparging system. Work was completed under several different regulatory agencies, including NYSDEC and NYCOER. Also provided presentations to school authorities, including the NYC DOE, to communicate the progress of the project and to educate administrators regarding the Site's environmental issues.

- **Lendlease Java Street Waterfront Redevelopment – Greenpoint, New York.** Principal-in-Charge for this large redevelopment project located on the waterfront in Greenpoint, New York. This 2.6-acre site is being redeveloped into a mixed-use development, including a residential tower, retail space, and a shoreline esplanade with NYC Ferry terminal access. This project incorporates many green and sustainability initiatives in its design. Work on this project has included due diligence support, involving the completion of a Phase I and Phase II ESA, NYSDEC BCP application, preparation of a Remedial Investigation Report and Remedial Action Work Plan, as well as supporting Lendlease in negotiation with NYSDEC to maximize site preparation and tangible tax credits. Work also included implementing an extensive In-situ Waste Characterization program, including PFAS investigation, negotiating soil reuse, and developing and implementing a complex remedial design program and community air monitoring program. The remedy for the site included design of a Sub-Slab Depressurization System (SSDS) to mitigate vapors beneath the future building, as well as negotiation with NYSDEC and NYCOER to ensure 421a schedule requirements were achieved. As part of this work, soil borings, monitoring wells, piezometers, and soil vapor monitoring points were installed, and hydrogeologic cross sections were prepared. Additionally, as part of this project, the tidal influence of the East River on site groundwater was studied, and a benthic sediment investigation was conducted in the East River.
- **Industrial Warehouse Development – Bayshore, New York.** Principal-in-Charge for a proposed industrial warehouse development located in Bayshore, Long Island, NY. As part of the project an initial Phase II investigation and PFAS evaluation was completed at this industrial site that contains a large former landfill. A BCP Application was prepared and is currently under review by NYSDEC.
- **Affordable Housing Development – Bronx, New York.** Principal- in-Charge for the redevelopment of a former US Postal Service Fleet Maintenance facility located in the south Bronx. This site will be redeveloped into a 100% affordable housing complex. I was retained to complete all initial due diligence activities, including PFAS investigation, and to evaluate possible NYSDEC BCP eligibility. Once determined the site is a good candidate for the BCP, we prepared a BCP Application, and all required reporting. We also ensured that the site met 421a schedule requirements throughout the development and implementation of an Interim Remedial Measures (IRM) Plan. Full scale remediation is currently underway, including the remediation of hazardous soils, removal of USTs, and removal of multiple hydraulic lifts. Responsibilities also included design of a Sub-Slab Depressurization System (SSDS) to mitigate vapors beneath the future building.
- **Chlorinated Solvent Remediation – Parsippany-Troy Hills, New Jersey.** Principal-in-Charge for the Remedial Investigation and Remedial Action implementation associated with a former dry cleaner release located in Parsippany-Troy Hills, New Jersey. We were retained by one of the largest real estate developers in the United States to complete this project. Soil, groundwater, and subsurface vapor were impacted with chlorinated VOCs as a result of the former dry cleaner operations. Responsibilities included the design and management of a Supplemental RI that included the installation of soil borings, monitoring wells and the completion of groundwater vertical profiling. Additionally, Mr. Kovacs was responsible for the design, implementation, and management of an extensive groundwater remediation injection program in which approximately 200,000 pounds of Zero-Valent Iron (ZVI) and 2,500 gallons of Emulsified Vegetable Oil (EVO) were injected into the subsurface using pneumatic fracturing. Initial post-treatment results show over 95 percent reduction in concentrations of chlorinated VOCs in groundwater. Furthermore, he was responsible for the design, installation, and operation of a SVE system to address impacted vadose zone soil.
- **Brookfield Hudson Exchange West – Jersey City, New Jersey.** Principal-in-Charge and LSRP for the first three towers as part of this mixed-income development near the Jersey City waterfront. Overall, this project will include 11 residential towers. To date, two towers are completed, and one is about to begin construction. I am LSRP of record for: Phase 1A (625,000 square foot, 35-story tower), Phase 1B (432 unit, 35-story tower), and Phase 2 (60-story tower, with 802 Units and ShopRite supermarket planned for the second floor). Responsibilities included all initial site investigation, remedial design, and remedial implementation. Additionally, I was responsible for all compliance with NJDEP requirements, including preparation and certification of all reports, preparation of Remedial Action Permits, issuance of RAOs, and implementation of all post remedial activities and reporting.

- **Residential/Commercial Redevelopment – Brooklyn, New York.** Principal-in-Charge for a mixed-use development located in Red Hook, NY. Completed Phase II investigation and designed and implemented several Interim Remedial Measures. Also advised client on the most advantageous regulatory pathway to implement the redevelopment project. We are currently in the process of submitting a BCP Application to NYSDEC.

- **Chlorinated Solvent Release – Bernardsville, New Jersey.** Principal-in-Charge for the investigation of an extensive chlorinated solvent plume emanating from a former dry cleaner site. Contamination from this site has migrated far off site in groundwater, and has potentially impacted nearby surface water. Work includes installation of soil borings and monitoring wells to characterize contamination in soil, perched water, groundwater in the deep unconsolidated aquifer zone, as well as groundwater in the weathered bedrock matrix and bedrock matrix. Further, contamination from the Site is co-mingled with contamination from other solvent release sites, complicating NJDEP negotiations and investigation/remedial requirements. Mr. Kovacs serves as the LSRP of record for this project.

- **UST Spill Site – Brooklyn, New York.** Principal-in-Charge for the investigation of a Spill in Williamsburg, Brooklyn, New York. M. Kovacs lead the project team in successfully demonstrating to NYSDEC's Spills Group that impacts to a deep groundwater zone beneath the client's site were a result of offsite contamination migrating onsite from a nearby active gasoline station (not a result of the client's former industrial operations). Impacts included the presence of several feet of free-product in a deep groundwater zone. Furthermore, he was successful in getting the client's Spill Case closed, saving the client from additional investigation activities, and what will likely be a multi-million-dollar remediation to address free-product beneath a semi- confining clay zone.

- **Former Vehicle Maintenance Facility – Parlin, New Jersey.** Project Manager for the removal of (2) waste oil USTs, a subsurface oil water separator, piping, and remediation of associated petroleum contaminated soil at a former vehicle maintenance facility in Parlin, New Jersey. Roux was retained by one of the largest real estate developers in the United States to complete this project. This remediation was completed to allow for a new, national tenant to occupy this retail space. As part of this work, it was determined that a historic release occurred from the OWS, triggering a RI for petroleum-related VOCs and chlorinated VOCs in soil. Mr. Kovacs was also responsible for the development and implementation of the Remedial Action for the Site, which included excavation and off-site soil disposal. SESOIL modeling was also utilized to demonstrate groundwater (approximately 100 feet deep) was not impacted by the shallow soil contamination. As part of this project, he took a lead role in preparing the SI Report, RI Report, RAW, RAR, Receptor Evaluation, and the Unrestricted Use RAO.

- **NJ Transit Active Bus Facility, New Jersey.** Project Principal for the completion of a RI at an active bus garage located in Fairview, New Jersey for a major transit agency. Responsibilities included the delineation of a free-product plume, characterization of soil and groundwater quality, report preparation, and correspondence with the NJDEP. Moreover, Mr. Kovacs was responsible for implementing free-product Interim Remedial Measure efforts. Currently, he is finalizing the RI report for the Site, and managing the Remedial Action design, and supporting the LSRP in meeting all NJDEP administrative requirements.

- **Residential Hi-Rise Development – Manhattan, New York.** Principal-in-Charge for a redevelopment site in mid-town Manhattan working for a private developer who is building a mixed-use retail/commercial tower. Work included a Phase I ESA and Phase II ESA. As part of the Phase II shallow bedrock was identified in portions of the site, and an LNAPL plume was identified in the overburden soils. Responsibilities included bedrock evaluation, LNAPL recovery utilizing multiple different techniques. Responsibilities also included construction support, health and safety support, management of all soil excavated and transported off site, and the design of a Sub-Slab Depressurization System (SSDS) to mitigate vapors in the vadose zone beneath the new building structure that were emanating from groundwater.

- **Ship Dry Dock Facility – Hoboken, New Jersey.** Project Manager for the completion of a Preliminary Assessment and Site Investigation (PA/SI) at an active ship dry dock facility in Hoboken, New Jersey. Responsible for the coordination and management of field investigation activities, which included soil, groundwater, and sediment sampling, as well as the preparation of a PA and SI report. This work was completed on behalf of a potential buyer of the property who planned to redevelop this site into a New York City ferry terminal.

- **BICC Cables – Yonkers, New York.** Project Manager for the investigation and remediation of the interior and subsurface soils of a former cable manufacturing facility located in Yonkers, New York to be redeveloped into a movie studio. Responsibilities included the completion of several large-scale investigations, including the collection of wipe, soil and building material samples to characterize PCB and lead impacts at this 200,000+ square foot facility Additional tasks included oversight of the remediation of interior surfaces using several different methods for the removal of PCBs and lead, and remediation of a sub-surface drainage trench and process water system. Further work included the preparation of a

Remedial Investigation report and a Feasibility Study report for submittal to the NYSDEC.

- **Amtrak Electrical Substation – Rahway, New Jersey.** Project Manager for the RI and RA design and implementation at an active electrical substation in Rahway, New Jersey for a national passenger railroad agency. Responsibilities included completing an RI to delineate PCBs in soil, and the management of free- product recovery programs. Further, Mr. Kovacs was responsible for managing the RA at the Site, which included soil excavation and offsite disposal, and free- product recovery. As part of this project, he supported the Site LSRP and took a lead role in preparing the Supplemental RI Report, RAW, RAR, Receptor Evaluation, and the Unrestricted Use RAO. Additionally, he assisted the LSRP in satisfying all NJDEP administrative requirements, including preparation of forms, public notifications, and submittal of fees.
- **Echo Bay Redevelopment – New Rochelle, New York.** Project Manager for the completion of Phase I and Phase II Environmental Site Assessment activities associated with a proposed mixed-use redevelopment located in Westchester, New York. Work included management of subsurface investigation activities to characterize soil conditions, and working closely with client's architects and construction contractors to integrate the proposed site remediation into the project development plan (including evaluating multiple potential disposal scenarios). Site contaminants included hydrocarbons (including free-product plume from former USTs), and historic fill constituents.
- **Former Dry Cleaner – Ramsey, New Jersey.** Project manager for the SI, RI, and vapor intrusion investigation at a former dry cleaner in Ramsey, New Jersey. Responsibilities included managing and coordinating field investigations, preparing remedial cost estimates for redevelopment, and preparation of reports and satisfying NJDEP Administration requirements. This work is being done to support redevelopment of the Site for a large, national fitness center tenant.
- **Former Service Station – Patterson, New Jersey.** Project Manager for the implementation of a groundwater remediation injection program to address petroleum contamination at a former service station located in Paterson, New Jersey for a major transit agency. Responsibilities included implementation of a PA and SI to further investigate chlorinated VOCs at this Site. As part of this project, Mr. Kovacs took a lead role in preparing reports and the Permit-by-Rule Request, as well as assisting in satisfying all NJDEP administrative requirements.
- **NJ Transit Active Railyard – Roxbury Township, New Jersey.** Project manager for the investigation of a diesel release at an active railyard in. This release was caused by a faulty underground pipe located in the locomotive fueling area. The diesel release resulted in a free-product plume, groundwater impacts, and impacts to a subsurface drainage culvert and a nearby lake. Responsibilities included the development and coordination of a field investigation program, coordination of routine gauging and free-product recovery events, correspondence with NJDEP, and preparation of a baseline ecological evaluation. Additionally, Mr. Kovacs supported the Site LSRP in meeting all NJDEP administrative requirements.

Facility Demolition/Decommissioning

- **Former Pharmaceutical Manufacturing Facility Decommissioning, Brooklyn, New York.** Project Manager for the interior decontamination and decommissioning of a 700,000+ square foot former manufacturing facility located in Brooklyn, New York to allow for redevelopment of the building for commercial, retail, and light industrial use, and use as a movie studio, and for local food businesses. This redevelopment has earned significant positive press, as it is considered a highly beneficial reuse for the community. This project included the development of decontamination and decommissioning work plan, technical support of bidding process, and full time onsite engineering support of the entire project.

  Decontamination and decommissioning activities included removal/cleaning of hundreds of air handling units and dust collector units impacted with manufacturing dusts and residues, as well as thousands of feet of intricate vacuum, ventilation, and dust collection lines. This project also included the removal of concrete impacted with metals, PCBs, and/or VOCs, selective interior demolition, and decontamination of former laboratory, milling, compounding, blending, and packaging areas, as well as asbestos abatement. At the conclusion of this project, a Final Report was prepared, documenting in detail the extensive work completed and that the work plan objectives were achieved.
- **Former Pharmaceutical Manufacturing Facility Demolition, Brooklyn, New York.** Project Manager for the demolition of two former manufacturing buildings in Brooklyn, New York. Both buildings were impacted with hazardous levels of PCBs, mercury, and lead. Responsibilities included in situ waste characterization of building materials, oversight of hazardous waste removal, completion of waste manifests, and full-time Community Air Monitoring during all demolition activities. Additionally, Roux Associates performed daily inspections and monitoring to ensure the protection of a nearby elementary school and prepared a completion report at the conclusion of the project.
- **PCB Building Material Remediation.** Principal-in-Charge for the investigation and TSCA remediation of PCB containing paint in a former manufacturing area. This location (approximately

2,000 square feet in area, and two stories in height) was found to contain PCBs in the paint matrix at concentrations as high as 10,000 parts per million. The underlying building material (brick, concrete, and terra cotta) was also found to be impacted with PCBs from the paint. Responsibilities included preparation of a Self-Implementing Notification and Alternative Decontamination Methods and Verification Sampling Work Plan to remediate the PCBs under the TSCA regulatory framework. This project also included providing field oversight of the PCB remediation, completion of the extensive verification sampling program of the underlying porous building material, and collection of confirmation air samples and confirmation wipe samples outside of the exclusion zone to confirm proper function of all critical barriers. Following the successful completion of the project, a Final Report was prepared and submitted to USEPA documenting the entire project in detail.

Expert/Insurance Litigation Support

- Consulting Fact Witness for an insurance litigation claim where insured was seeking to be reimbursed for more than $15 million of previous environmental investigation/remediation costs. Mr. Kovacs responsibilities included a formal deposition and testifying in US District Federal Court – Eastern District of New York. Case resulted in favorable ruling for our client.
- Consulting expert for a PRP to the Gowanus Canal Superfund Site, Brooklyn, New York. Evaluated all RI data, performed fate and transport analysis, and evaluation of historic site operations to support facility *de minimis* status.

PROFESSIONAL TRAININGS

OSHA 40-Hour Health and Safety Course (29 CFR 1910.120)

OSHA 8-Hour Health and Safety Refresher Course (29 CFR 1910.120)

PUBLICATIONS

Significant Acceleration of Time Frame to Closure via Transition from Long-Term Biological Treatment to ZVI/EVO Injection, Kovacs, R., Senh, S., Silverstein, W., Moss, D., Kelley, R., Proceedings of the Tenth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, 2016.

Strategy to Overcome Sub-Slab Depressurization System Design and Operational Challenges in an Existing Building With Sensitive Tenant Use, Henke, R., Kovacs, R., Kaiser, D., Proceedings of the Twelfth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, 2022.

PROFESSIONAL PROFILE

Omar Ramotar, PE

Principal Engineer

CONTACT INFORMATION

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Somerset, NJ 08873

EDUCATION

BE, Environmental Engineering, Hofstra University 1994
ME, Environmental Engineering, Manhattan College 1995

PROFESSIONAL LICENSES

Professional Engineer: New York, 2000

EXPERIENCE SUMMARY

Over twenty-seven years of experience: Staff, Project, Senior, and Principal Engineer with Roux.

TECHNICAL SPECIALTIES

Engineering services for the investigation, design, construction, operation, maintenance and monitoring of remedial systems for the remediation of contaminated soil, sediment, and groundwater.

REPRESENTATIVE PROJECTS

- Project Manager and Principal-in-Charge for a multi-element (large scale removal action [45,000 cubic yards of impacted materials excavated and consolidated on-site/disposed off-site], large scale subsurface feature and UST removal action, and remediation and restoration of a 3.2-acre seasonal pond located in the Massapequa Preserve) remedial design of a USEPA Superfund Site in Nassau County, New York. Responsible for the Preparation of USEPA response letters, technical drawings, and 95% and 100% remedial design documents in accordance with the Record of Decision and Consent Judgment.

- Project Manager and Principal-in-Charge for design of a natural wastewater treatment solution for a 3,000-acre new industrial complex in Saudi Arabia. Roux Associates was tasked to design an Engineered Natural System (to treat all wastewaters: sanitary, process and stormwater) from construction through operation, incorporate transitioning through phases, and plan for future expansion of the facility and increased wastewater flow rates. The 23-acre ENS was designed to treat a total flow of 1.4 million gallons per day. The major system components include: dump station with five truck hookup ports to collect and convey sanitary wastewater during construction of the facility; three primary sedimentation and anaerobic treatment tanks; one oil/water separator; six patented enhanced subsurface flow constructed treatment wetlands; two down flow disinfection filters; UV disinfection system; One treated water holding tank which conveys the treated water back to the facility for reuse within the refinery and as irrigations for landscaped areas; two infiltration basins; and six activated alumina treatment cells to remove fluoride from facility stormwater runoff.

- Project Manager and Principal-in-Charge for the bidding, contractor selection, and remediation of the wetland and canal portions of a 440-acre tract in western Staten Island that was used as a Major Oil Storage Facility (MOSF) for petroleum products until the end of 1995. Responsible for the preparation of a Remedial Action Work Plans, technical drawings, and 95% and 100% remedial design documents and for the remedial construction phase in accordance with the Site-specific Consent Order issued by the NYSDEC. Key elements of the Work include dredging/excavation of approximately 20,000 cubic yards of petroleum and lead impacted sediments/soils, off-site disposal, on-site capping and restoration of approximately 6.5 acres of disturbed wetlands. Routine activities included coordinating weekly construction meetings; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design, CAMP and project-specific erosion and sedimentation controls; and managing the overall project budget and schedule.

- Project Manager and Principal-in-Charge for the bidding, contractor selection, and remediation of a New York State Superfund Project. Responsible for the preparation of a Remedial Action Work Plans, technical drawings, remedial design documents and for the remedial construction phase in accordance with the Amended Record of Decision issued by the NYSDEC. Key elements of the Work include excavation and off-site disposal of approximately 20,000 tons of VOC impacted soils, on-site capping and in situ chemical oxidation. Routine activities included coordinating weekly construction meetings and preparing associated meeting minutes; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design, CAMP and project-specific soil erosion and sedimentation controls; and managing the overall project budget and schedule.

- Project Manager for the bidding, contractor selection, and remedial construction phase at a 40-acre former metals manufacturing facility in Staten Island under the NYSDEC Voluntary Cleanup Program. Responsible for overall construction management for dredging/stabilization and off-site disposal of approximately 7,000 cubic yards of metal-impacted sediments from a tidally influenced embayment area and creek system, off-site disposal of approximately 3,000 cubic yards of sediment, on-site consolidation of approximately 4,000 cubic yards of sediment; capping of fill material/bank stabilization; in-place abandonment of former water and sanitary sewer system; construction of an 8 acre asphalt cap, installation of new stormwater sewer system and restoration and mitigation of approximately 2 acres of wetland areas disturbed by ongoing remedial activities. Routine activities included coordinating weekly construction meetings; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design; and managing the overall project budget and schedule.
- Project Construction Manager for a NYCDEP storm and sanitary sewer construction project in Brooklyn, New York. Work included design and construction of approximately 690 linear feet of RCP storm sewer, approximately 725 feet of ductile iron sanitary sewer, 6 new house connection spurs, new sewer and sanitary manholes and 12,000 square feet of asphalt removal and replacement. Routine activities included coordinating weekly construction meetings; ensuring Contractor compliance with remedial design, CAMP and SWPPP implementation; and managing the overall project budget and schedule.
- Project Manager for the preparation of a Feasibility Study Report and ongoing remediation of a 40-acre former manufacturing facility in Rensselaer, New York as part of the NY State Superfund Program. Responsible for the preparation and implementation of multiple large-scale IRM soil removal remedial actions resulting in approximately 12,000 tons of non-hazardous waste and 10,720 tons of hazardous waste shipped off-site. Also, responsible for the preparation and implementation of the remediation of two 80,000-square foot former wastewater treatment lagoons. Approximately 7,000 cubic yards of hazardous waste sediments shipped off-site. Approximately 4,000 cubic yards of riprap lining the perimeter of both lagoons mechanically screened to remove interstitial sludge within the riprap matrix. NYSDEC approval gained for on-site reuse of 3,200 tons of riprap saving the client approximately $400,000 in disposal costs. Provided ongoing support for various tasks associated with constructing, operating and maintaining the on-site groundwater treatment system.
- Principal Engineer and Project Manager for On-Site Environmental Monitor (OEM) Program implemented at the largest redevelopment project in New York City (over $5 billion). Required to ensure environmental compliance with regards to air, stormwater, noise, traffic, and other relevant environmental concerns during the performance of any construction related activity across the 22-acre redevelopment project Site. The Project consists of the construction of 30 buildings (commercial and residential); eight (8) acres of public open space and approximately 1,200 below grade parking spaces and some retail and community facility uses. The Project also includes the development and construction a new storage and maintenance rail yard facility for the Long Island Rail Road (LIRR) below grade across two city blocks over which a platform will be constructed along with six of the Project buildings and some of the open space.

Additional Soil and Groundwater Remediation Experience

- Principal in Charge and Project Manager for the preparation and implementation of a Remedial Action Work Plan (RAWP) at a former ink ribbon and carbon manufacturer in Glen Cove, New York. Scope of work included the removal of approximately 20,000 tons of listed-hazardous toluene-contaminated soil at various final excavation depths within 1.4-acre area, followed by ISCO injections across the excavated area. All on-site sources of contamination were removed, and on-site groundwater was remediated to Site cleanup levels within 18 months from initiation of Site construction activities. Prepared Final Engineering Report (FER) and Site Management Plan (SMP) as required by the NYSDEC.
- Principal in Charge and Project Manager for the source-area excavation and treatment of groundwater and soil grossly impacted by light non-aqueous phase liquid (LNAPL), volatile organic compounds (VOCs), and hazardous materials at a 33,150 square foot lot entered into a NYSDEC Brownfield Cleanup Agreement site in

Long Island City, New York. Prepared and certified the NYSDEC-required Remedial Action Work Plan, Site Management Plan and Final Engineering Report. Remediation efforts included removal of approximately 5,000 tons of grossly contaminated material removal using steel sheet piling and disposal/abandonment eleven (11) underground storage tanks (USTs) ranging in size from 2,000 to 25,000+ gallons that contain diesel fuel/fuel oil, mineral spirits, and linseed oil. In Situ Chemical Oxidation (ISCO) injections completed to address residual VOC contamination in soil and groundwater during the performance of the remedial action.

- Project Manager for the remedial design and remediation of a 23-acre former municipal landfill located in Glen Cove, New York as part of the NY State Superfund Program. The work was performed in accordance with Title 3 of the NYS Environmental Quality Bond Act under contract to the City of Glen Cove. Design elements included excavation of hazardous and radiological waste (8,500 cubic yards in total), 44,000 cubic yards of bulky waste, VOC and radiological waste monitoring, demo debris and waste separation and screening, dewatering, waste disposal, capping and site restoration. Additional work included the de-listing of a six acre "clean" portion of the site to allow the development of a ferry terminal and esplanade and development of alternative cleanup standards consistent with future site uses. Site remediation will accommodate site redevelopment as a commercial waterfront and operating ferry service and seaport area.
- Project Manager for the investigation and remediation of several sites spanning multiple blocks for a major pharmaceutical company in Brooklyn, New York. Environmental investigation is being conducted in preparation of possible property transfer. Responsibilities include development and preparation of investigation and remedial action work plans and coordination and management of resulting field investigation and remediation efforts. Project Engineer for a SVE/AS system to treat groundwater contaminated with VOCs and chlorinated VOCs at one 0.8-acre block. Designed and performed two SVE/AS pilot studies. Designed the full-scale SVE/AS system. Managed bidding, contractor selection, remedial construction, system start-up, operation, maintenance and monitoring phases for the full-scale SVE/AS system.
- Project Manager for the design of a soil and groundwater remediation system for a nationwide overnight delivery distribution center in Brooklyn, New York as part of the NYSDEC Voluntary Cleanup Program. A risk based remedial approach that called for the remediation of "hot spot" source area soils and mass-reduction of VOCs was successfully utilized for the Site. As a result, the focus of remediation was on reducing the mass of VOCs in on-site groundwater to a level where natural attenuation would be effective in remediation of VOCs. To address the contamination in the source area, a SVE/AS system consisting of 8 SVE wells and 17 AS wells was designed, constructed, operated, and maintained for a period of approximately 3 years. The SVE/AS system has been permanently shut down and the Site is currently in the post-remediation monitoring phase.
- Project Manager for the remediation of a former major pharmaceutical plant located in Hicksville, New York as part of the NY State Superfund Program. The project consisted of the excavation of non-hazardous soil from 5 on-site drywells and a former waste disposal area, implementation of a community air monitoring plan, coordination with the Long Island Rail Road (LIRR) for work performed within the LIRR's right of way, steel sheeting installation and removal, backfilling, monitoring well abandonment and replacement, transportation and disposal of 3,300 tons of VOC, SVOC and metal contaminated soil, and restoration of approximately 9,800 square feet of asphalt. A 7-foot diameter steel caisson was used to support the deeper excavation required at the invert of two drywells. This innovative approach saved the client approximately $50,000 in costs that would have been incurred by using a traditional steel sheeting support system to protect the on-site commercial building.
- Project Engineer for the complete design, implementation, and startup of five distinct air sparge (AS) and soil vapor extraction (SVE) systems for the remediation of gasoline contaminated groundwater and soils. Pilot studies were performed at several locations at an 850-acre petroleum terminal site in Rhode Island and lead to the design of full-scale AS and SVE remediation systems that are being used in a phased approach, to remediate selected areas of the site. The designs included specialized modeling techniques to determine the optimum system requirements and components.
- Project Engineer for the design and construction management of a soil remediation project at a 28-acre former pesticide warehouse facility in Dayton, New Jersey. The project consisted of the excavation and on-site consolidation and capping of 7,500 cubic yards of pesticide contaminated soil. The capped areas were designed to be incorporated into a Site re development

plan for use as a storage and trailer parking lot. A Soil Erosion and Sedimentation Control Plan and a NJPDES General Permit were prepared for the project.

- Project Engineer for the design and remediation of a former sanitary wastewater leaching system at a 16.6-acre NYS RCRA site in Bethpage, New York. The project consisted of the excavation, staging, transportation, and disposal of VOC, SVOC, metal and pesticide contaminated soil. Approximately, 5,100 tons of non-hazardous soil, 1,300 tons of hazardous metals contaminated soil and 350 tons of hazardous VOCs contaminated soil. Structures remediated consisted of an imhoff tank, 33 leach pools, 2 distribution boxes, 2 stormwater drains, 2 sludge drying beds, and a blast fence area.
- Staff Engineer for the preparation and implementation of a Soil IRM plan for a major pharmaceutical plant in Brooklyn, New York as part of the NYSDEC Voluntary Cleanup Program. Work elements included contractor plan preparation, steel sheeting and removal, excavation of hazardous and non-hazardous waste, VOC and particulate monitoring, dewatering water management, waste transportation, disposal, and tracking, backfill placement and compaction. IRM Soil remediation included excavation of over 1,620 tons of non-hazardous soil and 524 tons of hazardous soil.
- Senior Engineer for design and construction of several elements of a 40 gpm treatment system for a 40-acre former manufacturing facility in Rensselaer, New York. BASF Site. Design support for 4,000 linear feet of collection trenches, 7 extraction well vaults, 2 air release chambers, and 2 groundwater re-injection galleries and a 50 foot by 60-foot treatment system containment pad. Coordination of construction efforts between mechanical and electrical contractors.
- Project Engineer for preparation and certification of Final Engineering Report and Site Management Plans for remediation of a 40-acre former metals manufacturing facility in Staten Island under the NYSDEC Voluntary Cleanup Program. Remediation included dredging/stabilization and off-site disposal of approximately 7,000 cubic yards of metal-impacted sediments from a tidally influenced embayment area and creek system, off-site disposal of approximately 3,000 cubic yards of sediment, on-site consolidation of approximately 4,000 cubic yards of sediment; capping of fill material/bank stabilization; in-place abandonment of former water and sanitary sewer system; construction of an 8 acre asphalt cap, installation of new stormwater sewer system and restoration and mitigation of approximately 2 acres of wetland areas disturbed by ongoing remedial activities. Routine activities included coordinating weekly construction meetings and preparing associated meeting minutes; preparing detailed NYSDEC monthly construction progress reports; ensuring Contractor compliance with remedial design; and managing the overall project budget and schedule.
- Project Engineer for preparation of Final Engineering Report and Site Management Plan for the remediation of a 40-acre former manufacturing facility in Rensselaer, New York as part of the NY State Superfund Program. Remediation included: multiple large-scale IRM soil removal remedial actions resulting in approximately 12,000 tons of non-hazardous waste and 10,720 tons of hazardous waste shipped off-site; remediation of two 80,000-square foot former wastewater treatment lagoons; groundwater containment and treatment system construction and Site-wide capping.

Additional Feasibility Study Experience

- Principal Engineer for the preparation of a Feasibility Study Report for a NYS Superfund Site in Glen Cove, New York. The Site is approximately 15 acres in size with a 1.4-acre portion of the site impacted by historical disposal of industrial wastes. Approximately 10,000 cubic yards of non-hazardous and hazardous waste has been identified to be potentially shipped off-site.
- Principal Engineer for preparation of a Focused Feasibility Study to optimize ongoing free-product recovery efforts for an 18-million-gallon release of petroleum hydrocarbon product from a former refinery and petroleum storage terminal in Brooklyn, New York. The remedial action objectives of the feasibility study were removal of free product to the extent practicable, prevention and/or elimination of any product seeps from the Site that result in visual petroleum product sheens on surface water and eliminate through removal, treatment, and/or containment the source of surface water contamination to the extent practicable. Technologies evaluated and retained included: Excavation, skimming, dual pump liquid extraction, water flooding, surfactant enhanced subsurface remediation, cosolvent flushing, vapor enhanced fluid recovery, enhanced fluid recovery, and natural source zone depletion.
- Project Manager and Senior Engineer for the preparation of a Remedial Action Selection (RAS) Report for a 9-acre landfill in Rensselaer, New York as part of the NYSDEC Voluntary Cleanup Program. The primary goal of the

RASR was to select a remedial alternative that was most protective of human health and the environment under the contemplated future use of the Site as a landfill with an integrated wildlife habitat vegetative cap. The final remedy for the landfill will include 1,000 linear feet of perimeter groundwater collection trenches, a 40-gpm treatment system for metals and VOCs and excavation and in situ chemical oxidation of VOC source areas.

- Project Engineer for the preparation of a Focused Feasibility Study (FFS) Report for the remediation of two dry wells at a formerly government owned, contractor operated, 105-acre New York State RCRA site in Bethpage, New York. The soils below and in the vicinity of each drywell were contaminated at various locations from 2 to 55 feet below land surface (bls) with PCBs exceeding NYSDEC standards. The FFS evaluated the following options: no action, in situ thermal desorption and excavation and off-site disposal. The no action alternative was recommended because the Site characterization and exposure assessment results indicated that there was no potential risk to persons using the Site for commercial or industrial activities, PCB impacted soils had been previously excavated to a depth of 28 feet bls and because PCBs are generally immobile in the environment, so migration is unlikely.

Additional Miscellaneous Design Experience

- Project Engineer for the design and construction management of a private vehicle fueling area at a New York City railyard. System components included: UST and process piping, level/monitoring systems, pump dispenser and keycard system, pump island, canopy and fire suppression system. Design met all substantive requirements of the New York City Fire Department (NYCFD) and New York City Department of Buildings (NYCDOB). Tasks included equipment selection, equipment sizing, piping layout, preparation of plans and specifications and shop drawing review and approval.

Additional Stormwater Design Experience

- Project Engineer for the design and construction management of a stormwater drainage project for a 28-acre former chemical pesticide manufacturing facility located in Dayton, New Jersey. The stormwater drainage system consisted of multiple catch basins, over 2,000 linear feet of reinforced concrete pipe ranging in size from 15 to 30 inches, and a recharge basin. The TR 55 computation method was used to size the drainage system for a 25-year storm event. The drainage system was designed in strict accordance with the New Jersey Department of Environmental Protection (NJDEP), the New Jersey Soil Conservation District (NJSCD) and the local planning departments.

Additional Engineered Natural System Design Experience

- Senior Engineer for the design of a compost treatment (CT) cell retrofitted into an existing sludge drying bed located at an integrated aluminum smelting and fabricating facility in Massena, New York. The principal objective of the CT will be to remove and sequester low level PCBs in the Site wastewater stream prior to discharge to the Site's permitted outfall. The proposed CT cell will be incorporated into the wastewater treatment process to evaluate PCB treatability in a CT environment as an alternative to other technologies currently being considered for the Site. The CT cell will be designed to accommodate variable hydraulic loading rates (10 to 70 gpm) and retention times in order to evaluate and define optimal system performance.

- Senior Engineer for the design of two pilot scale compost treatment (CT) systems for stormwater management at an active aluminum manufacturing facility in Lafayette, Indiana. The design included the retrofit of a 1,000 gallon above-grade septic tank (to handle a variable flow of 0.1 to 1 gpm) and a 100,000 gallon above-grade storage tank (to handle a variable flow of 10 to 50 gpm). The remedial goal of the pilot CT systems is for the removal of PCBs and aluminum from stormwater currently collected in the on-Site 100,000-gallon storage tank. The pilot systems were designed for incorporation into the existing stormwater system, thus precluding the need for additional permitting. The systems have been designed for year-round operation.

- Senior Engineer for the development of design improvements for a 45-acre former Landfill in Holtsville, New York to minimize the source of contamination to a downgradient pond and its' associated creek. A detailed budget water analysis was performed comparing current and proposed conditions to determine the best methods to minimize infiltration into the landfill and divert the stormwater runoff to the onsite recharge basin and away from the landfill. The proposed strategy currently entails modifying the existing stormwater conveyance controls (i.e., lining drainage swales), reducing the permeability of the landfill surface through the addition of recreational areas and lined stormwater storage ponds, and planting hybrid poplar trees to increase evapotranspiration at the Landfill. Overall, these modifications would be expected to reduce annual infiltration in the landfill surface from 24 inches to 18 inches, equivalent to approximately 8.2 million gallons of water annually.

- Project Engineer for the design of structural SMPs to manage runoff generated from a LEED certified 70,000 ft2 athletic facility, which is being constructed as part of a redevelopment of a 110-acre park facility in Staten Island, New York. Innovative structural stormwater management practices incorporated into the Site design include the following: micropool extended detention pond and infiltration basin. The pond will be comprised of a sedimentation forebay, shallow marsh, and pond. Suspended solids will drop out as runoff passes through the forebay, thereby enhancing treatment performance, reducing maintenance, and increasing the longevity of the system. The permanent pool provides additional dry storage capacity to mitigate peak flow rates prior to discharge into the overflow meadow. The forebay and pond are designed with shallow ledges along its fringe to support aquatic marsh plants. These wetland plants will aid in the stormwater treatment by impeding flow and trapping contaminants as they enter the forebay and pond. The fringe vegetation will stabilize and protect deposited sediments from resuspension during large storm events. The fringe wetland plants will include species such as rushes, reeds, and sedges, designed to improve water quality through the trapping and filtering of fine particles and soluble pollutants (metals, organics, and nutrients). Effluent from the micropool extended detention pond will then be discharged to an infiltration basin (i.e., Overflow Meadow) planted with a variety of native wildflower and wetland species for groundwater recharge.
- Project Engineer for the design of a pilot constructed treatment wetland system to treat stormwater discharge from an aluminum manufacturing facility located in Massena, New York. The 0.3-acre treatment system uses activated alumina and compost filter cells, and a sub-surface flow wetland to treat 1,400-4,300 gallons of stormwater daily.

Additional Operation and Maintenance (O&M) Experience

- Senior Engineer responsible for supporting the OM&M of a 40 gpm treatment system for a 40-acre former manufacturing facility in Rensselaer, New York. Processes and system maintained include aeration, bag filtration, air stripping, metals adsorption, liquid, and vapor phase carbon adsorption.
- Senior Engineer responsible for the O&M and monitoring of a soil vapor extraction (SVE) and air sparge (AS) system for nationwide distribution center in Brooklyn, New York as part of the NYSDEC Voluntary Cleanup Program. O&M activities included system operation and maintenance, performance monitoring, soil gas monitoring, quarterly monitoring, and preparation of quarterly and annual status reports for submission to the NYSDEC. The SVE and AS system consists of 8 SVE wells and 17 AS wells and was designed, constructed, operated and maintained for a period of approximately 3 years. The SVE and AS system has permanently shut down and the Site is currently in the post-remediation monitoring phase.
- Project Engineer responsible for the O&M of a 430 gpm, dual-phase, product recovery system in Greenpoint, Brooklyn, New York. Processes and system maintained include dual-phase groundwater and product recovery, low profile air strippers and a catalytic oxidation unit. The Site encompasses one of the nation’s largest petroleum releases (18 million gallons).
- Project Engineer for the metals removal system upgrade of a 430 gpm, dual-phase, product-recovery system in Greenpoint, Brooklyn, New York. Upgrades included design, procurement, and construction oversight to install a metals removal system, allowing the remedial system to run at full capacity with minimal O&M. The metals removal system included two 10-foot diameter continuously backwashing sand filters, process liquid aeration system and ancillary equipment. The pre-design phase also included the performance of an extensive bench study to optimize the system design.
- Project Engineer for the control system upgrade of a 430 gpm, dual-phase, product-recovery system in Greenpoint, Brooklyn, New York. Upgrade included design procurement and construction oversight to install a new control system to eliminate intermittent power surges and sags which, in combination with the communication problems, had caused the previous control system to operate unpredictably. These upgrades included installation of new remote input/output systems, new uninterruptible power supplies and new remote communication cables at all six remote well sites.
- Staff Engineer for the O&M of a product recovery system in Howard Beach, New York. O&M activities include system maintenance and performance monitoring through on-site and off-site monitoring wells.
- Staff Engineer for the O&M of a 40 gpm groundwater remediation system at an industrial facility in Queens, New York as part of the State Superfund Program. O&M activities included system maintenance, effluent sampling, quarterly monitoring, and preparation of quarterly and annual status reports for submission to the NYSDEC.

- Staff Engineer for the design, implementation, and O&M for two remedial treatment facilities to remediate groundwater impacted by leaking USTs at two service garages owned by a New York state telecommunications company. The system was designed to treat groundwater at a flow-rate between 5 and 10 gpm using granular activated carbon adsorption treatment units.

Additional Health and Safety Management or Facility Decontamination or Demolition Experience

- Principal Engineer for the decontamination and decommissioning (D&D) of a 700,000+ square foot facility, in Brooklyn, New York for a major pharmaceutical company. The D&D activities were performed to allow for future use of the former facility for commercial, retail, and/or industrial purposes after renovation and redevelopment by others, by removing, cleaning, encapsulating or otherwise abating: (1) contaminants in indoor concrete identified during previous environmental investigations, (2) pharmaceutical manufacturing residues in ductwork identified during previous environmental investigations, (3) pharmaceutical manufacturing residues in select existing manufacturing infrastructure [including but not limited to relic air handling units (AHUs), dust collection systems, and air exhaust units], and performing partial interior building demolition and cleaning in connection with such infrastructure, (4) the horizontal drain piping associated with the eighth floor laboratories, and (5) paint containing polychlorinated biphenyls (PCBs) at a concentration of 50 milligrams per kilogram (mg/kg) or greater.
- Senior Engineer responsible for providing both worker and community Health and Safety through the monitoring of air particulates and VOCs during the electrical upgrade of pharmaceutical manufacturing facility in Brooklyn, New York. All work was performed in accordance with OSHA, NYSDEC and USEPA protocols for worker and community health and safety monitoring.
- Senior Engineer responsible for providing both worker and community Health and Safety through the monitoring of air particulates and VOCs during the construction of a parking lot redevelopment project for a pharmaceutical manufacturing facility in Brooklyn, New York. All work was performed in accordance with OSHA, NYSDEC and USEPA protocols for worker and community health and safety monitoring.
- Staff Engineer and Site Health and Safety Officer for the decommissioning of a pharmaceutical manufacturing facility in Brooklyn, New York. Responsibilities included construction oversight of all contractors for the following: dewatering, removal of 26 USTs ranging in capacity up to 30,000 gallons, excavation and stabilization of soil contaminated with VOCs, lead and mercury, and disposal of all waste generated. Additional responsibilities included providing both workers and community Health and Safety through the monitoring of air particulates, VOCs, and mercury vapors. All work was performed in accordance with OSHA, NYSDEC and USEPA protocols for worker and community health and safety monitoring.
- Staff Engineer and Site Health and Safety Officer providing construction oversight and management for the completion of a building demolition and UST Removal Program at a metals manufacturing facility in Staten Island, New York. The project included asbestos and lead abatement oversight prior to building demolition activities and the removal of six 550-gallon gasoline USTs, one 1,000-gallon No. 2 fuel oil UST and one 600-gallon No 2 fuel oil UST. A total of four buildings, two smelting kettles, a 200-foot emissions stack and a 50-foot water tower were removed as part of the demolition program. Responsibilities included providing both worker and community Health and Safety through the monitoring of air particulates and VOCs, performing all required sampling, waste disposal tracking to document all activities performed, providing construction oversight of all contractors, and preparing weekly progress reports.

Additional UST Experience

- Staff Engineer for the excavation oversight of 11 gasoline USTs, one waste oil UST, three pump islands and all associated underground and aboveground piping at a national railroad company in Queens, New York. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal of the USTs and preparation of a Closure Report.
- Staff Engineer for the excavation oversight of three 8,000-gallon USTs, two pump islands and all associated piping at a service station in Greenwich, New York. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal, cleaning, and disposal of the USTs and preparation of a Closure Report.

PROFESSIONAL TRAININGS

OSHA 40-hour Health & Safety Course, 1995

OSHA 8-hour Health & Safety Refresher Course, 1996-2021

Julia Michaels

Project Scientist

TECHNICAL SPECIALTIES

Management and field implementation of Remedial Investigations for sites in regulatory programs including the New York State Brownfields Cleanup Program (BCP) and the New York City Office of Environmental Remediation Volunteer Cleanup Program. Management and field implementation of Phytoremediation Plots, Wetland Delineation, and Forest Management. Preparation, and management of Remedial Investigation Work Plans and Remedial Investigation Reports. Remedial construction and soil excavation oversight, management of waste characterization and removal, environmental site assessments focusing on soil, groundwater and soil vapor investigations using multiple sampling techniques.

EXPERIENCE SUMMARY

Five years of experience: Project Scientist, Staff Scientist, Staff Assistant Scientist; Roux Environmental Engineering and Geology, D.P.C., Islandia, New York.

CREDENTIALS AND TRAINING

B.S. Environmental Science, Villanova University, 2018

B.A. Geography, Villanova University, 2018

OSHA 40-Hour HAZWOPER Training, 2018

OSHA 10-Hour Construction Safety Training, 2018

OSHA 30-Hour Construction Safety Training, 2019

OSHA 8-Hour Refresher Training, Certificate Current

LIRR Contractor Safety and Security Training, 2018

Transportation Worker Identification Credential, 2018

First Aid and CPR Certified, 2019

KEY PROJECTS

- Project manager for the inspections of a 75-acre hybrid poplar phytoremediation plot as a component of closure on an active petroleum refinery and terminal in East Providence, Rhode Island as part of an implemented Engineered Natural System. The phytoremediation plot is designed to hydraulically control and remediate contaminants from a dissolved-phase groundwater plume. The performance evaluation includes tri-annual seasonal monitoring and growth measurements, modeling of evapotranspiration, evaluation of recent groundwater measurements, and supporting the authoring of the annual report to be submitted to the Rhode Island Department of Environmental Management.
- Project Manager for the Remedial Action Groundwater Monitoring contaminated with VOCs and chlorinated solvents at a 0.8-acre NYSDEC Voluntary Cleanup Site in Brooklyn, New York. Responsibilities include NYSDEC correspondence, report preparation, work plan preparation, and field staff management for groundwater quarterly groundwater sampling.
- Project Manager for a freshwater pond nutrient analysis and mitigation investigation in Southampton, New York. Project objective was to assess nutrient loading, and mechanically remove nutrient sources. Responsibility included design, sampling, and analysis of groundwater and surface water, as well as prepare a conceptual plan for mechanical means of removal.
- Project Manager for former fibers facility in Williamsburg, Virginia. Project components include land management for wildlife enhancement projects, Phytotechnology monitoring, and permitting. Baseline vegetation survey completed including mapping of all habitat types present. Wildlife monitoring surveys for bats, birds, amphibians, reptiles, mammals and insects. Wildlife projects implemented include creation of pollinator meadow areas, warm season grasslands, sustainable forestry management, purple martin colony, blue bird trail, bat housing, native bee housing, and vernal pool monitoring. Wildlife Habitat Council Wildlife at Work certification earned for wildlife projects.
- Field manager for the nontidal wetland delineation of a park in North Hempstead, New York. Responsibility included preparation of field documents and assisting in performing the wetland delineation, collection of GPS points, and development of post delineation report and figure.
- Field Manager for neighboring redevelopment Sites in the NYSDEC BCP, located in Bronx, New York. Responsibilities included implementing a Community Air Monitoring Program (CAMP), managing soils including transportation and disposal, collecting *in situ* waste characterization soil samples, and maintaining communication between subcontractors and Roux office support.

- Field manager for the Remedial Investigation of a redevelopment Site in East Orange, New Jersey that contained seven former and one operating dry cleaner, three former fueling stations, and a former automotive repair shop. Responsibilities included oversight of New Jersey-specific monitoring well installation and collection of soil and groundwater samples for suspected contamination of chlorinated solvents.
- Field manager of a Phase II investigation of surface water nutrient loading at a site in East Hampton, New York. Field responsibilities included oversight of piezometer well installation, and field management of groundwater sampling and surface water sampling at twenty-two locations along a tidally influenced creek.
- Field manager for Phase II investigation at a Site in Glen Cove, New York. The Site formerly operated as an ink ribbon and carbon manufacturer, and portions of the Site were previously remediated under the NYS Superfund and the USEPA RCRA Closure Programs. Responsibilities included soil vapor, soil, sediment, and groundwater sampling and implementation of a methane delineation program.
- Assisted in the implementation of a large-scale waste characterization program for a major redevelopment project in Elmont, New York. Project included coordination and oversight of *in situ* waste characterization sampling of over 405,000 tons of soil.
- Assisted in annual groundwater sampling monitoring program at a former petroleum refinery and terminal in Brooklyn, New York. This work was done to monitor the largest subsurface free-product plume in North America. Fieldwork responsibilities included the sampling of over fifty wells for petroleum contaminated groundwater using multiple sampling methods.
- Assisted in the Pre-Design Investigation and Waste Characterization sampling event for a New York State BCP project in Brooklyn, New York. The site was an automotive dealership and maintenance facility with heavy petroleum and chlorinated solvent contamination in the soil and groundwater. Field responsibilities included oversight of Geoprobe direct push rig, health and safety oversight, *in situ* waste characterization, and groundwater sampling.
- Field manager of a Phase II remedial investigation for due diligence support at a site in New Rochelle, New York. Field responsibilities included soil vapor sampling, groundwater sampling, and soil sampling to investigate recognized environmental concerns on behalf of a potential buyer.
- Site Safety Officer for various remedial investigation sites. Responsibilities include preparation of health and safety plans (HASPs); job safety analysis (JSA) documents development and review; onsite safety meeting management; safety document preparation (Lessons Learned, Near Loss, Field Audits, etc.); and planning/execution of corrective actions.

APPENDIX B

Job Safety Analysis (JSA) Forms

JOB SAFETY ANALYSIS	**Cntrl. No.**	DATE:	☒ NEW ☐ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE	WORK ACTIVITY (Description)

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

- ☐ LIFE VEST
- ☐ HARD HAT
- ☐ LIFELINE / BODY HARNESS
- ☐ SAFETY GLASSES
- ☐ GOGGLES
- ☐ FACE SHIELD
- ☐ HEARING PROTECTION
- ☐ SAFETY SHOES
- ☐ AIR PURIFYING RESPIRATOR
- ☐ SUPPLIED RESPIRATOR
- ☐ PPE CLOTHING:
- ☐ GLOVES:
- ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment:

Commitment to LPS – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

EXCLUSION ZONE: A _ foot exclusion zone will be maintained around (indicate equipment).

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. [INSERT JOB STEP]	**1a. CONTACT:** [INSERT HAZARD]	1a.
	1b. CAUGHT: [INSERT HAZARD]	1b.
	1c. FALL: [INSERT HAZARD]	1c.
	1d. EXPOSURE: [INSERT HAZARD]	1d.
	1e. EXERTION: [INSERT HAZARD]	1e.
	1f. ENERGY SOURCE: [INSERT HAZARD]	1f.
2. [INSERT JOB STEP]	**2a. CONTACT:** [INSERT HAZARD]	2a.
	2b. CAUGHT: [INSERT HAZARD]	2b.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into five types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

	2c. FALL: [INSERT HAZARD]	2c.
	2d. EXPOSURE: [INSERT HAZARD]	2d.
	2e. EXERTION: [INSERT HAZARD]	2e.
	2f. ENERGY SOURCE: [INSERT HAZARD]	2f.

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-023**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Construction**	WORK ACTIVITY (Description) **Spotting Heavy Machinery**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Levi Curnutte	Project Scientist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST	☐ GOGGLES	☐ Particulate Respirator	☒ GLOVES: Cut resistant / leather
☒ HARD HAT	☐ FACE SHIELD	☐ SUPPLIED RESPIRATOR	☐ OTHER:
☒ LONG SLEEVED SHIRT	☐ HEARING PROTECTION	☒ PPE CLOTHING: Fluorescent reflective clothing	
☐ LIFELINE / BODY HARNESS	☒ SAFETY SHOES: Steel-/Composite-toe boots/shoes		
☒ SAFETY GLASSES			

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Heavy Machinery (i.e. excavator, payloader, truck, forklift, etc.)

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Prepare for machine activity.	**1a. CONTACT:** Obstructions in the work area may create contact hazards from machinery. **1b. Fall :** Slip/Trip/Fall	1a. Cordon off the work area with safety barrels/cones and a rigid barrier (snow fence, traffic bar, etc.). Communicate that only necessary personnel should be in the work area. Spotter and equipment operator shall enforce the **EZ.** Operator will not operate but shall remain in the hands-off mode while personnel are within the exclusion zone. 1b. Ensure that work area is flat, level and clear of any obstructions or debris before setting up work zone.
2. Spotting.	**2a. CONTACT:** Machine or load contact with personnel, property, or machinery.	2a. Discuss the specifics of the work with the operator and be clear about any hand signals that will be used. Clearly discuss the limits of the assigned work area and the machine's Exclusion Zone. Maintain Exclusion Zone. The Exclusion Zone shall be delineated by using 42-inch traffic cones/barrels and a fixed rigid barrier. 2a. The Minimum Heavy Equipment Exclusion zone is greater than the swing/tip radius of equipment. 2a. Both the spotter and equipment operators shall have 2-way radios/cellular devices on their persons to ensure audible communication in the event any changes or new hazards may arise. 2a. All workers should stay outside of the Exclusion Zone of all equipment unless operator is stopped and in "Hands Off" mode. **(This includes the spotter unless an exception has been established in the Site-specific JSA).** If the Exclusion Zone must be reduced due to work area restrictions then the spotter and operator shall enforce the reduced Exclusion Zone. 2a. Spotters must make eye contact with the machine operator or all movement ceases until visual contact can be reestablished. 2a. Spotter shall keep an eye out for any issues with the machine the operator may not see and communicate with other work crews and spotters on behalf of the operator. 2a. If the spotter needs to take a break, he must find a replacement before leaving or have the machine stop operations. **No heavy equipment shall operate without a spotter under any circumstances.** 2a. Wear fluorescent clothing/safety vest.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
	2b. FALL: Slip/Trip/Fall	2b. Look where walking to identify and avoid slip/trip/fall hazards. Avoid icy and/or wet surfaces. Remove obstacles if possible. 2b. Use designated walkways during spotting whenever possible.
	2c. CAUGHT: Caught between machinery and nearby objects.	2c. **Maintain Exclusion Zone.** Do not stand between large, loose or fixed objects or structures and the machinery while it is in motion. Keep in sight of operator at all times while being aware of surrounding structures.
	2d. EXPOSURE: Inhalation of exhaust from machinery.	2d. The spotter will position him/herself upwind of the working machinery, when possible. Spotter will also inform others working within the vicinity of the EZ of proper positioning, if applicable.

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JOB SAFETY ANALYSIS	**Cntrl. No. GEN-027**	**DATE: 11/3/2020**	☒ NEW ☐ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Drilling**	WORK ACTIVITY (Description) **Pre-Drilling Clearance, Vactron and Air Knife**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Courtney Rempfer	Staff Scientist	Joseph Midwig	Office Health & Safety Manager
Sara Redding	Senior Hydrogeologist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☒ FACE SHIELD (While Air Knifing) ☒ HEARING PROTECTION (As needed) ☒ SAFETY SHOES: Composite toe or steel toe boots	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing; long-sleeve shirt	☒ GLOVES: Leather, Nitrile, cut-resistant ☒ OTHER: Dusk mask, insect repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Vac-Truck or Vac Drum, Compressor, Jack Hammer, Air Knife. Circular Saw, Hand Tools, Dust Mask, Photoionization Detector, Multi Gas Meter, 42 inch safety cones and flags, Retractable Cone Bars, Caution Tape, 20 lb. Fire Extinguisher, “Work Area” Signs, Pressurized Water Sprayer

Commitment to Safety – All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE: All non-essential personnel will maintain a distance of 10 feet from drilling equipment while equipment is moving/engaged

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Verify pre-clearance protocol	**1a. CONTACT:** Underground utility damage; property damage; personal injury	1a. Confirm that (if applicable) “Call Before You Dig” and local utility companies were contacted prior to starting work in order to confirm utility mark outs. Must have a case # before digging. 1a Walk the Site to evaluate utility markings and review maps (see Site Walk Inspection JSA). Utilities are not always properly marked out ensure use of observational skills through the pre-clearing checklist. 1a. Review pre-clearing checklist fromm and sub-surface clearance form. Pre-clearing protocol indicates that clearance must be conducted to a minimum of 5 vertical feet below ground surface or 10 vertical feet below ground surface in the critical zone using hand tools.
	1b. ENERGY SOURCE/CONTACT: Property damage; Pressurized water mains may cause lacerations or broken bones. Pressurized gas mains may explode causing serious injury, or death. Underground electric may cause severe burns, shock, or death.	1b. Pre-clearing of each soil boring/monitoring well location must be conducted to a minimum of 5 vertical feet below the ground surface (10 feet minimum for Critical Zone) using hand tools (shovel and non-metallic dig bar and hand auger) prior to drilling. Supervisor should be contacted to discuss appropriate pre-clearing depth. 1b. MUST Complete subsurface clearance checklist prior to pre-clearance.
	1c. FALL: Slip, Trip or Fall may cause muscle strains or tears, abrasions, lacerations, or broken bones.	1c. Be aware of the conditions when walking or loading equipment and working. Walk within established pathway avoiding uneven surfaces. Remove potential slip/trip/fall hazards.
2. Mobilize/demobilize and establish work area	**2a. SEE MOBILIZATION / DEMOBILIZATION JSA**	2a. See Mobilization / Demobilization JSA
3. Concrete saw cutting, jack hammer and hand clearance with hand tools, air knife	**3a. CONTACT:** Flying debris striking face or body	3a Maintain 10’ minimum exclusion zone. Use the required PPE (i.e., leather/cut proof gloves, safety glasses/face shield). 3a. Use anti-whip devices on compressor hoses. 3a Wear a face shield to protect face from flying debris when using air knife. 3a. Utilize a traffic cone or physical barriers over the hole during air knife activities to keep flying debris close to ground.
	3b. EXPOSURE: Inhalation/exposure to hazardous vapors and/or concrete dust, noise exposure	3b. Monitor breathing zone with a calibrated PID and/or multi-gas meter. If meters sustain readings greater than recommeneded in the HASP for the specific contaminant of concerns (COCs) the Roux field personnel must temporarily cease work, instruct all Site personnel to step away from the area of elevated readings. Contact PM. 3b. Wet concrete while using saw to minimize dust and wear dust mask to prevent inhalation. 3b. Stand upwind and keep body behind saw. Observers and helpers should avoid line of fire for saw blade. Always cut away from body. 3b. No open flames/heat sources. 3b. Wear hearing protection when saw, jackhammer or air compressor are in operation. Otherwise, if sound levels exceed 85 dbA, put on hearing protection.
	3c. ENERGY SOURCE/CONTACT: Property damage; Pressurized water	

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	mains may cause lacerations or broken bones. Pressurized gas mains may explode causing serious injury, or death. Underground electric may cause severe burns, shock, or death. **3d.ERGONOMICS/EXERTION:** Muscle strain due to poor body positioning when handling equipment and materials **3e. FALL:** Tripping/falling due to uneven terrain, weather conditions, and materials/equipment stored at the Site **3f. CAUGHT:** Amputation points associated with the equipment and vacuum hose	3c. For air knifing, ensure extention/lance tip reaches the full 5 feet bgs. Air knife should be advanced **AT A MINIMUM** in all four corners of the expected boring location to find any possible arrangement of utilities. 3c. Ensure diameter of soil preclearance hole is at a **MINIMUM 2x** the diameter of any drilling or hard dig equipment that will be entering the hole. 3c. See Complete subsurface clearance protocol for information provided above. 3d. Use body positioning and lifting techniques that minimizes muscle strain; keep back straight, lift with legs, keep load close to body, and never reach with a load. 3d. Ensure that loads are balanced to reduce the potential for muscle strain. 3d. Two people or a mechanical lifting aid are required when lifting objects over 50 lbs. or when the shape makes the object difficult to lift. 3e. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. Mob/Demob JSA. 3e. Do not climb over stored materials/equipment; walk around. Practice good housekeeping. 3e. Use established pathways and walk on stable, secure ground. 3e. Equipment and tools will be stored at the lowest point of potential energy and out of the walkway and immediate work area (i.e. tools should not be propped against walls or nearby equipment or vehicles). 3e. Equipment and tools that are not anticipated to be used will be returned to a storage area that is out of the immediate work area. 3e. Ensure power cords and compressed air lines are grouped when used within the work area. 3e. Pre-cleared location will be finished flush to grade as to prevent a slip/trip hazard or coned and taped off. 3f. Always wear leather gloves when making connections and using hand tools; wear cut-resistant (i.e., Kevlar) gloves when handling cutting tools. 3f. Inspect the equipment prior to use for potential pinch points. 3f. Test all emergency shutdown devices prior to using equipment. 3f. Inspect saw blade for worn surface or missing teeth; switch blade if damaged or blunt. 3f. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body. 3f. All non-essential personnel shall maintain a 10 foot exclusion zone; position body out of the line-of-fire of equipment. 3f. Drillers and helpers will understand and use the “Show Me Your Hands Policy”.
4. Move drum to staging area using drum cart	**4a. EXPOSURE/CONTACT:** Contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated groundwater, soil) **4b. EXERTION:** Muscle strain while maneuvering drums with drum cart/lift gate **4c. CAUGHT: Pinch points associated with handling drum lid**	4a. Wear Nitrile chemical-resistant gloves under leather or cut proof gloves. 4a. Do not overfill drums. Ensure that the drum lids are attached securely. 4a. All drums will be staged in the designated storage area. 4b. See 3d. Do not overfill drums. Use lift gate on back of truck to load and unload drums. Use drum dolly to move drum. 4c. Ensure that fingers are not placed under the lid of the drum. Wear leather gloves or cut proof gloves. Use appropriate ratchet while sealing drum lid.
5. Decontaminate equipment.	**5a. EXPOSURE/CONTACT**: To contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated groundwater, vapors). **5b. EXPOSURE:** To chemicals in cleaning solution.	5a. Wear chemical-resistant disposable gloves and safety glasses. 5a. Contain decontamination water so that it does not spill. 5a. Use an absorbent pad to clean spills, if necessary. 5a. Spray equipment from side angle, not straight on, to avoid backsplash. 5a. See 3b. 5b. See 4a. Review SDS to ensure appropriate precautions are taken and understood.

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JOB SAFETY ANALYSIS Ctrl. No. CVD-19	DATE: 01/05/2022	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Fieldwork**	WORK ACTIVITY (Description) **Working in Areas Affected by Coronavirus**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Kristina DeLuca	Health and Safety Specialist	Brian Hobbs	CHSD
		Ray Greenidge	Sr. Compliance Mgr.

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT – In field ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES – In field	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES – Steel/composite toe in fie	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING – High visibility vest in field	☒ GLOVES – Leather/cut-resistant in field and nitrile as needed ☒ Face Covering

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Cloth face covering, nitrile gloves, hand soap, water source, hand sanitizer, disinfectant spray and disinfectant wipes.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

SOCIAL DISTANCING: Maintain 6’ of distance between yourself and all other people at all times. If you do not believe the scope of work can be conducted while maintaining this distance, contact your Project Manager immediately.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Project Preplanning	N/A	• Review and follow COVID-19 CDC, Roux, Client and local orders/protocols. • Ensure all workers are fit for duty - anyone feeling sick should remain at home even if symptoms do not align with COVID-19. If a worker has been in contact with someone potentially positive or positive for COVID-19, contact your Office Manager. • Determine PPE needs and ensure adequate supply of disinfectant wipes/spray, soap and water or hand sanitizer at Site. Due to high demands and limited supply, plan ahead. • Use the minimum number of employees necessary to safely complete the work.
2. Mobilization	**Exposure:** Becoming infected or infecting co-workers	**Personal/Rental/Roux Owned Vehicle** • Do not carpool, unless all individuals are fully vaccinated. • Verify workers/other people are not approaching vehicle prior to exiting the vehicle. Maintain 6’ of distance from general public, as appropriate. **Public Transportation** • Public transit should not be used unless absolutely necessary. Consider renting a car rather than taking public transit. If public transit is required, wear appropriate face covering/mask and apply social distancing (6 ft). Wash hands or use hand sanitizer immediately after. **Hotel Stay (Refer to COVID-19 H&S Guidance for more info)** • If a hotel stay is deemed necessary for the given field work, ensure that you clean your room upon initial arrival. • Place the “Do Not Disturb” placard on the room while away and limit housekeeping services to the extent feasible during your stay to minimize the reintroduction and spread of the virus from others. Wash hands or use hand sanitizer often.
3. Tailgate Meeting	**Exposure:** Becoming infected or infecting co-workers	• Perform outside or indoors in areas with ample ventilation. • If unvaccinated, maintain at least a 6+ ft distance between you and others. • Discuss primary infection prevention measures listed below. • Discuss COVID-19 symptoms with coworkers and subcontractors to ensure fitness for duty. Anyone exhibiting signs or symptoms should be instructed to leave the Site, contact your Project Manager.

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4. Site Activities	**Exposure:** Becoming infected or infecting co-workers	• Coordinate field activities at the beginning of the day (i.e. Tailgate meeting) to minimize time spent in crowded spaces or overlap while completing job tasks. • Don cloth face coverings as appropriate. • Apply social distancing (6+ ft) when interacting with others if unvaccinated. If anyone comes within 6 ft of you while conducting work and your work prevents you from moving away, politely ask them to move back. If others are unable to move from your space, stop work and leave area. • Minimize shaking hands or touching others. • Minimize sharing of equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g. nitrile gloves), as appropriate. • If anyone is experiencing COVID-19 signs or symptoms in your vicinity, stop work and leave the area. • Do not work in areas with limited ventilation with others. • Cover your mouth and nose with tissue or paper towel or with your elbow when coughing or sneezing and wash hands or use hand sanitizer immediately after. If sick contact SHSO/PM and leave Site immediately. • Clean work surfaces/areas with approved cleaners you're responsible for (ex: desk, office doorknob, computer, etc.) at least daily. • Avoid public spaces and going out to eat by bringing your own lunch to the Site. If performing work in high density urban areas, it is recommended all food must be consumed at or in your vehicle or within designated work trailer. Wash hands or use hand sanitizer before eating and immediately after.

Primary Infection Prevention Measures

- Wash your hands often with soap and water for at least 20 seconds.
  - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% alcohol. Key times to wash hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
- Do not touch your eyes, face, nose and mouth with unwashed hands.
- Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw potentially contaminated items (e.g. used tissues) in the trash.
- Avoid close contact/secondary contact with people and potentially contaminated surfaces.
  - Apply appropriate social distance (6+ feet).
  - Minimize handshaking/touching others and use caution when accessing public spaces.
- Clean frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboard, toilets, sinks and field equipment. If surfaces are dirty, they should be cleaned with soap and water prior to disinfection. If surface cannot be cleaned/disinfected, then wash hands or use sanitizer as soon as possible.

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JOB SAFETY ANALYSIS Ctrl. No. GEN-006	DATE 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **Generic**	WORK TYPE: **Drilling**	WORK ACTIVITY (Description): **Direct Push Soil Borings / Well Installation**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Timothy Zei	Project Hydrogeologist	Raymond Olson	Office Health & Safety Manager
		Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION: (as needed) ☒ SAFETY SHOES: Composite-toe or steel toe boots	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing, Long Sleeve Shirt	☒ GLOVES: Leather, Nitrile and cut resistant ☒ OTHER: Insect Repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Geoprobe or Truck-Mounted Direct Push Drill Rig, Hand Tools, Photoionization Detector, Multi-Gas Meter (or equivalent), Macrocore liners, Liner Opening Tool, 20 lb. Type ABC Fire Extinguisher, 42" Cones & Flags, "Work Area" Signs, Water

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

"SHOW ME YOUR HANDS"

Driller and helper should show that hands are clear from controls and moving parts

Assess ¹JOB STEPS	Analyze ²POTENTIAL HAZARDS	Act ³CRITICAL ACTIONS
1. Mobilization of drilling rig (ensure the Subsurface Clearance Protocol and Drill Rig Checklist are completed)	**1a. CONTACT:** Equipment/property damage.	1a. The drill rig's tower/derrick will be lowered and secured prior to mobilization. 1a. A spotter should be utilized while moving the drill rig. If personnel move into the path of the drill rig, the drill rig will be stopped until the path is again clear. Use a spotter for all required backing operations. 1a. Set-up the work area and position equipment in a manner that eliminates or reduces the need for backing of support trucks and trailers. 1a. When backing up truck rig with an attached trailer use a second spotter if there is tight clearance simultaneously on multiple sides of the equipment or if turning angles limit driver visibility. 1a. Inspect the driving path for uneven terrain. Level or avoid if needed. 1a. Drill rig should have a minimum **exclusion zone which encompasses its tip radius** for non-essential personnel (i.e., driller helper, geologist) when the rig is moving/ in operation.
	1b. FALL: Slip/trip/fall hazards.	1b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 1b. Do not climb over stored materials/equipment; walk around. Practice good housekeeping. 1b. Use established pathways and walk on stable, secure ground.
	1c. CONTACT: Crushing from roll-over.	1c Geoprobe should cross all hills/obstructions head on with the mast down to reduce risk of roll-over.
2. Raising tower/derrick of drill rig	**2a. CONTACT:** Overhead hazards.	2a. Prior to raising the tower/derrick, the area above the drilling rig will be inspected for wires, tree limbs, piping, or other structures, that could come in contact with the rig's tower and/or drilling rods or tools. 2a. Maintain a safe distance of 10' from overhead structures.
	2b. CONTACT: Pinch Points/Amputation Points when raising the rig and instability of rig	2b. Inspect the equipment prior to use and avoid pinch/amputation points. 2b. Lower outriggers to ensure stability prior to raising rig tower/derrick. 2b. If the rig needs to be mounted, be sure to use three points of contact.
3. Advancement of drilling equipment and well installation	**3a. CONTACT:** Flying debris	3a. Be aware of and avoid potential lines of fire and wear required PPE such as eye, ear, and hand protection.
	3b. EXPOSURE: Noise and dust.	3b. Wet borehole area with sprayer to minimize dust. 3b. Stand upwind and keep body away from rig. 3b. Dust mask should be worn if conditions warrant. 3b. Wear hearing protection when the drill rig is in operation.

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[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Advancement of drilling equipment and well installation (Continued)	**3a. CONTACT:** Flying debris **3b. EXPOSURE:** Noise and dust. **3c. FALL:** Slip/trip/fall hazards. **3d. CAUGHT:** Limb/extremity pinching; abrasion/crushing. **3e. CONTACT:** Equipment imbalance during advancement of drill equipment. **3f. EXPOSURE:** Inhalation of contamination/vapors. **3g. EXERTION:** Potential for muscle strain/injury while lifting and installing well casings, lifting sand bags, and/or lifting rods.	3c. Contain drill cuttings and drilling water to prevent fall hazards from developing in work area. 3c. See 1b. 3d. Ensure all Emergency Safety Stop buttons function properly. 3d. Always wear leather gloves when making connections and using hand tools; wear cut-resistant (i.e., Kevlar) gloves when handling cutting tools. 3d. Inspect the equipment prior to use for potential pinch/amputation points. Keep hands away from pinch/amputation points and use of tools is preferable compared to fingers and hands. 3d. Inspect drill head for worn surface or missing teeth; replace if damaged or blunt. 3d. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body. 3d. All non-essential personnel should stay away from the immediate work area; position body out of the line-of-fire of equipment. 3d. Drillers and helpers will understand and use the “Show Me Your Hands” Policy. 3d. Spinning rods/casing have an **exclusion zone of tip radius** while in operation. 3e. Drillers will advance the borehole with caution to avoid causing the rig to become imbalanced and/or tip. 3e. The blocking and leveling devices used to secure the rig will be inspected by drillers and Roux personnel regularly to see if shifting has occurred. 3e. In addition, personnel and equipment that are non-essential to the advancement of the borehole will be positioned away from the rig at a distance that is at least as far as the boom is high (**minimum exclusion zone**). 3f. Monitor ambient air for dangerous conditions using a calibrated photoionization detector (PID) to periodically monitor the breathing zone of the work area. 3f. If a reading of >5ppm is recorded, the Roux field personnel must temporarily cease work, instruct all Site personnel to step away from the area of elevated readings and inform the Roux PM of the condition. The Roux PM will then recommend additional precautions in accordance with the site specific health and safety plan. 3f. Use a multi-gas meter to monitor ambient air for dangerous conditions (i.e. unsafe levels of carbon monoxide when drilling indoors or the presence of explosive vapors). 3g. Keep back straight and bend at the knees. 3g. Utilize team lifting for objects over 50lbs. 3g. Use mechanical lifting device for odd shaped objects.
4. Remove sample liner.	**4a. EXERTION:** Potential for muscle strain/injury while removing liner from probe rod. **4b. CONTACT:** Pinch points and cuts **4c. EXPOSURE:** Inhalation and/or dermal contact with contaminants.	4a Utilize team lifting for objects over 50lbs. 4a. Use hydraulic liner extruder if available. 4b. Place liner on sturdy surface when opening. 4b. Don cut-resistant gloves and use appropriate liner cutter when opening liners. 4b. Always cut away from the body. 4c. Wear chemical-resistant disposable gloves when handling liners. 4c. See 3e.
5. Decontaminate equipment.	**5a. EXPOSURE/CONTACT**: To contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated groundwater, vapors). **5b. EXPOSURE:** To chemicals in cleaning solution including ammonia.	5a. Wear chemical-resistant disposable gloves and safety glasses. 5a. Contain decontamination water so that it does not spill. 5a. Use an absorbent pad to clean spills, if necessary. 5a. Spray equipment from side angle, not straight on, to avoid backsplash. 5a. See 3b. 5b. See 4a. Review SDS to ensure appropriate precautions are taken and understood.

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-007**	DATE 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **General Site Activity**	WORK ACTIVITY (Description) **Driving**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Valerie Sabatasso	Staff Scientist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST	☐ GOGGLES	☐ AIR PURIFYING RESPIRATOR	☒ GLOVES: Leather/ cut-resistant level 2
☒ HARD HAT: when outside vehicle	☐ FACE SHIELD	☐ SUPPLIED RESPIRATOR	☐ OTHER _____
☐ LIFELINE / BODY HARNESS	☒ HEARING PROTECTION	☒ PPE CLOTHING: high visibility vest, when outside vehicle	
☒ SAFETY GLASSES:when outside vehicle	☒ SAFETY TOE BOOTS: when outside vehicle		

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Motor Vehicle (i.e. car, truck, SUV)

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Driving to/leaving Site	**1a. CONTACT:** Severe injury/disability, property damage, monetary loss (insurance premiums, deductibles, loss of license/job) caused by collision with or struck by other vehicles, obstructions, pedestrians, animals, etc. *Common factors that may lead to CONTACT incident, but not limited to: • distracted driving (cell phone, GPS, radio, billboards, “rubber necking”) • lack of situational awareness • unfamiliarity with traffic patterns/road layout • weather conditions (wet/icy roads, hydroplaning, black ice) • weariness • high speeds • obstructed vision (solar glare, debris on windshield, blind spots) • changes in travel pathway (construction, snow banks, non-operational signals, potholes, detours, special events) • improper vehicle maintenance (non-operational signal light, worn tires, cracked windshield, ineffective wipers) • loose or unsecure objects	1a. PLAN AHEAD – review/make yourself familiar with maps and driving directions before beginning the drive to the Site. Do not attempt to drive and review maps/directions at the same time. Pull over and stop your vehicle before looking at maps/directions. 1a. Complete a basic vehicle inspection before driving. Verify Inspection and Registration are current, tires and wipers are in good condition, all lights are functional, all glass/mirrors are undamaged, the horn is functional, roof/hood/trunk are free from accumulated snow and visibility is not impaired due to snow/ice/frost/fog on windows. 1a. Do not hang items in car that can obstruct your view or become projectiles in a collision. 1a. Do not get distracted using touch screen radios or GPS units built into newer models. Keep your eyes on the road and stay alert. 1a. Follow posted speed limits and obey traffic signals and roadway signs. 1a. Always wear your seat belt and shoulder harness when driving. 1a. When driving around large vehicles and trucks, maintain extra space as these vehicles may not be able to see a smaller car too close. 1a. Follow the "Rules of the Road" including: using your turn signals, coming to a complete stop, and allowing vehicles the right of way (yield) when they are when traffic laws require. 1a. Apply the Smith Five Keys® of safe driving • Aim High in Steering® - Expand eye lead time to a minimum of 15 seconds • Get the Big Picture® - Maintain proper a 4 second minimum following distance at all times - Scan mirrors every 5-8 seconds to achieve a circle of awareness - Position your vehicle so you can see relevant/non-relevant objects • Keep Your Eyes Moving® - Try to maintain about 180 degrees of visibility - Avoid blank and fixed stares. Avoid focusing on one object for more than 2 seconds • Leave Yourself an Out® - Avoid traveling in traffic clusters - Surround yourself with space - Anticipate the actions of others

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Driving to/leaving Site (cont'd)	**1a. CONTACT:** Severe injury/disability, property damage, monetary loss (insurance premiums, deductibles, loss of license/job) caused by collision with or struck by other vehicles, obstructions, pedestrians, animals, etc.	• Make Sure They See You® - Maintain eye contact with on-coming vehicles/pedestrians - Use warning devices (e.g., hand signals, high-lights, horns etc.) - Proper timing is essential 1a. Do not perform reconnaissance or inspections while driving. Your vehicle should be parked in a safe location when viewing or surveying the Site and vicinity 1a. Avoid sudden turns and stops. Don't drive recklessly – be in control of vehicle at all times. 1a. In inclement weather, first determine if work can be POSTPONED. Otherwise, plan according to weather conditions including checking forecast along entirety of travel route (especially, for long distances). Reduce speed as road conditions warrant. Travelling with winter car equipment, in the winter, is strongly recommended (i.e., shovel, scraper, brush, blanket, extra clothing, flashlight, bag of sand). If your vehicle has 4-wheel drive, review to operators manual and understand operating procedure prior to engaging 4-wheel drive. If at any point on your drive weather becomes too severe to proceed safely pull over if safe to do so or seek nearest cover (e.g., overpass) 1a. If feeling drowsy or sleepy, do not drive. Pull over in a safe place to rest if you experience any signs of drowsiness. Make sure to get adequate sleep the night before an early drive. 1a. Never operate a vehicle under the influence of alcohol or illegal substances or medications affecting your performance. 1a. Keep your eyes on the road. Do not call or talk on cellular phones. Pull over to a safe location if you must answer or make a call. 1a. When parking, pull-through when possible. If backing is required visually inspect area to ensure it is free from obstructions prior to backing in and relying solely on mirrors; use spotters when available.
2. Entering/Exiting Vehicle.	**2a. CAUGHT:** Personal injury (broken fingers/hand) while entering or exiting vehicles **2b. FALL:** Personal injury (twisted ankle, deep contusion, concussion, broken wrist/arm, etc.) from slip/fall on uneven or unstable or slippery surface while exiting/entering vehicle **2c. CONTACT:** Severe injury/disability, property damage, monetary loss (insurance premiums, deductibles, loss of license/job) caused by collision with or struck by other vehicles, obstructions, pedestrians, animals, etc.	2a. Open and close doors slowly. Never put hands or feet in between door and vehicle to avoid pinch points. 2b. When exiting the vehicle make sure your feet are on firm footing and weight is evenly distributed before exiting/standing. In inclement weather use hands to support yourself, by holding the car door and/or steering wheel, when exiting the vehicle. 2c. Check both directions for traffic before opening door. Do not exit vehicle if traffic does not permit you to exit safely 2c. Check anticipated path of door prior to opening, do not open door into any obstructions (e.g., bollards, high curbing)

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-014**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **Generic**	WORK TYPE: **Drilling**	WORK ACTIVITY (Description): **Hollow Stem Auger Soil Borings / Well Installation**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Douglas Ferraiolo	Staff Geologist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☒ GOGGLES: Spoggles required if winds exceed 15 mph. ☐ FACE SHIELD ☒ HEARING PROTECTION: (as needed). ☒ SAFETY SHOES: Steel or Composite Toe.	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent long-sleeve shirt or long-sleeve shirt and reflective safety vest.	☒ GLOVES: Leather, Cut-Resistant, and Nitrile. ☒ OTHER: Insect Repellant, Sunscreen (as needed).

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Truck-Mounted Drilling Rig or Track Rig, Saw, Hand Tools, Photoionization Detector, Multi-Gas Meter (or equivalent), Interface Probe, 20 lb. Type ABC Fire Extinguisher, 42" Cones & Flags, "Work Area" Signs.

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

"SHOW ME YOUR HANDS"
Driller and helper should show that hands are clear from controls and moving parts

Assess ¹JOB STEPS	Analyze ²POTENTIAL HAZARDS	Act ³CRITICAL ACTIONS
1. Mobilization / demobilization and establish a work area.	**1a. See Mobilization/ Demobilization JSA GEN-015.**	1a. See Mobilization / Demobilization JSA GEN-015.
2. Raising tower / derrick of drilling rig.	**2a. CONTACT:** Overhead hazards. **2b. CONTACT:** Amputation / crush points when raising the rig and instability of rig.	2a. Prior to raising the tower / derrick, the area above the drilling rig will be inspected for overhead hazards (wires, tree limbs, piping or other structures) that may be contacted by the rig's tower or drilling rods. 2a. The tower / derrick must not be raised beneath overhead power lines unless approved by the Roux PM. 2a. Maintain a minimum of 10' from all overhead structures. 2a. Do not move the rig while the tower / derrick is raised. 2b. Inspect the equipment prior to use and avoid any potential amputation points. 2b. Lower outriggers to ensure stability prior to raising rig tower derrick. Keep feet and body out of the line of fire when lowering out-riggers. 2b. Inspect the set-up location for uneven terrain. Level or avoid area if needed. 2b. If the rig needs to be mounted, be sure to use three points of contact.
3. Advancement of augers for soil boring installation.	**3a. CONTACT:** Equipment imbalance during advancement of drill equipment. **3b. CONTACT:** Flying / spraying debris. **3c. CAUGHT:** Limb/extremity amputation, abrasion, and crushing.	3a. Drillers will advance the borehole with caution to avoid causing the rig to become imbalanced and / or tip. 3a. The blocking and leveling devices used to secure the rig will be inspected by drillers and Roux personnel regularly to see if shifting has occurred. **3a. Drillers will maintain the "Purple Zone" policy surrounding augers to ensure no personnel come into contact with augers while in use. Workers will spray paint a 3' semi-circle surrounding the augers to visually show that no personnel should enter the "Purple Zone" while drilling activities are being conducted.** 3a. In addition, personnel and equipment that are non-essential to the advancement of the borehole will be positioned away from the rig at a distance that is at least as far as the boom is high (minimum exclusion zone of 20 feet). 3b. Wear all required PPE (especially hand, eye, and ear protection). 3b. Maintain minimum EZ distance (i.e. swing/tip radius of rig) when rig is in operation to avoid potential line of fire hazards from flying materials or debris. 3c. Inspect the equipment prior to use for potential pinch points. 3c. Test all emergency shutdown devices prior to drilling. 3c. Inspect drill head for worn surface or missing teeth; replace if damaged or blunt. 3c. Inspect augers, do not use if auger flight is damaged or bent.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Advancement of augers for soil boring installation (Continued).		3c. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body. 3c. All non-essential personnel should stay away from the immediate work area; position body out of the line-of-fire of equipment particularly when installing auger flights and steel override casings. 3c. Drillers and helpers will understand and use the “Show Me Your Hands” Policy. 3c. Spinning augers should have an exclusion zone of 20 feet when in operation.
	3d. FALL: Slip/trip/fall hazards.	3d. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 3d. Do not climb over stored materials/equipment; walk around. Practice good housekeeping. 3d. Use established pathways and walk on stable, secure ground. 3d. Use three points of contact when mounting or dismounting the rig. 3d. Remove soil cuttings to avoid a tripping hazard from developing near augers.
	3e. EXPOSURE: Inhalation of contamination / vapors.	3e. Air monitoring using a calibrated photoionization detector (PID) to periodically monitor the breathing zone of the work area. 3e. The Action Level for breathing zone air is five parts per million (sustained) as detected by the PID. 3e. If a reading of >5ppm is recorded, the Roux field personnel must temporarily cease work, instruct all Site personnel to step away from the area of elevated readings and inform the Roux PM of the condition. The Roux PM will then recommend additional appropriate precautions in accordance with the site specific health and safety plan.
	3f. EXPOSURE: Noise and dust.	3f. Wet borehole area with sprayer to minimize dust. Stand upwind and keep body positioned away from rig. 3f. Wear hearing protection while drill rig is operating and / or the noise levels exceed 85 dBA.
	3g. EXERTION: Installing well casings and lifting augers.	3g. Keep back straight and bend at the knees. 3g. Utilize team lifting for objects over 50lbs. 3g. Use mechanical lifting device for odd shaped objects.
4. Installation of well materials.	**4a. CONTACT:** Installing well materials while also pulling up augers.	4a. Potential contact with augers during installation of well materials. 4a. Keep distance from augers and do not place any materials while augers are in motion.
	4b. CAUGHT: Possible pinch or crush hazard assembling PVC and sending down the borehole.	4b. Keep all body parts out of potential pinch points while placing PVC together and sending down borehole.
	4c. FALL: Slip/trip/fall hazards with hand tools and materials.	4c. See 3d.
	4d. EXPOSURE: Potential contamination, harmful vapors, dust, and / or noise.	4d. See 3e and 3f. 4d. Stand upwind to avoid exposure to dust generated from packing materials.
	4e. EXERTION: Lifting heavy bags of materials to backfill borehole.	4e. Ergonomic hazard lifting bags of sand and bentonite while packing the well.
5. Cleaning the auger flights	**5a. CONTACT:** Cuts/scrapes or puncture wound from contacting auger.	5a. Follow “Show Me Your Hands” Procedure and make sure auger is out of gear before contacting auger with tool or hand. 5a. Pull cleaning tool across your body with handle away from body; do not push toward the auger. 5a. Do not clean more than ¾ turn around the auger at a time. 5a. Wear cut resistant and leather gloves. 5a. Always use two hands to operate cleaning tool. 5a. Inspect tool before use and remove from service if handle or metal are cracked/fatigued. 5a. Stand out of the line of fire.
6. Decontaminate equipment.	**6a. EXPOSURE / CONTACT:** To contamination (e.g., contaminated groundwater, vapors).	6a. Wear chemical-resistant disposable gloves and safety glasses. 6a. Contain decontamination water so that it does not spill. 6a. Use an absorbent pad to clean spills, if necessary.
	6b. EXPOSURE: To chemicals in cleaning solution (including ammonia).	6b. See 3e. Wear all appropriate PPE and stand upwind of any exposed cleaning solutions.

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JOB SAFETY ANALYSIS **Ctrl. No. GEN-015**	DATE: 01/07/2022	☐NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Mobilization/Demobilization**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Tim Unalp	SHSO	Brian Hobbs	CHSD
Ray Greenidge	Sr. Compliance Manager		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION (as needed) ☒ SAFETY SHOES: Steel Toe or composite toe	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest of high-visibility clothing; long sleeve shirt; long pants	☒ GLOVES: Leather, nitrile, and cut resistant (as needed) ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: Varies

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Mobilize/demobilize and establish work area	**1a. FALL:** Slip/trips/falls from obstructions, uneven terrain, weather conditions, heavy loads, and/or poor housekeeping.	1a. Use 3 points-of-contact/ensure secure footing when entering and exiting vehicle. 1a. Inspect walking path for uneven terrain, steep hills, obstructions, and/or weather-related hazards (i.e., ice, snow, and puddles) prior to mobilizing equipment. Use established pathways. Walk on stable/secure ground. 1a. Do not climb over stored materials/equipment; walk around. Practice good housekeeping; organize and store equipment neatly in one area at its lowest potential energy. 1a. Wear boots with adequate treads. 1a. Delineate unsafe areas with 42” cones, caution tape and/or flagging.
	1b. CONTACT: Personal injury and/or property damage caused by being struck by Site traffic or equipment used in Site activities.	1b. Observe and maintain the posted speed limits. 1b. When first arriving onsite, park vehicles in designated parking space and/or out of the way locations. Use parking brake on all vehicles and tire chocks on work trucks and trailers. 1b. Check in with Site Manager/Supervisor to ensure coordination with other Site activities and to discuss any special hazards. Ensure that short-service employees (SSE) are identified. 1b. Identify potential traffic sources. 1b. Wear PPE including high visibility clothing or reflective vest. 1b. Use a spotter while moving work vehicles; plan ahead to avoid backing whenever possible. 1b. Maintain a minimum exclusion zone when vehicles are in motion (i.e. greater than swing/tip radius of equipment). When backing up truck rig with an attached trailer use a second spotter if there is tight clearance simultaneously on multiple sides of the equipment or if turning angles limit driver-to-spotter visibility. 1b. Delineate work area with 42” cones, flags, caution tape, and/or other barriers. 1b. Position “Work Area” signs at Site entrances, if possible, or at either side of work area.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
		1b. Position largest vehicle to protect against oncoming traffic. 1b. Face traffic, maintain eye contact with oncoming vehicles, use a spotter, and establish a safe exit route. 1b. Observe potential overhead and ground surface features that may interfere with moving equipment. Clear the path of physical hazards prior to initiating mobilization.
	1c. CAUGHT: Personal injury from pinch points and being in line-of-fire of vehicle and/or equipment.	1c. Make sure driver has engaged parking brake and placed wheel chocks in a position to prevent movement. Be sure that vehicle is parked in front/down gradient (positioned to best block oncoming traffic) of work area. 1c. Wear leather gloves when handling any tools or equipment. Wear cut-resistant gloves (Kevlar or similar) when handling sharp objects/cutting tools/glass. 1c. Keep body parts away from line-of-fire of equipment. 1c. Always carry tools by the handles and/or designated carrier. Ensure sharp-edged tools are sheathed/secure. 1c. Remove any loose jewelry. Avoid wearing loose clothing and/or ensure loose clothing is secure. 1c. Secure all items on the equipment, tighten up any items or features that have potential to shift or break during mobilization.
	1d. OVEREXERTION: Muscle strains while lifting/carrying equipment.	1d. Use body positioning and lifting techniques that avoid muscle strain; keep back straight, lift with legs, turn with whole body, keep load close to body, and never reach with a load. 1d. Ensure that loads are balanced. Use assistance (mechanical or additional person) to carry equipment that is either unwieldy or over 50 lbs.
	1e. EXPOSURE: Personal injury from exposure to biological and environmental hazards.	1e. Inspect area to avoid contact with biological hazards (i.e. poisonous plants, stinging insects, ticks, etc.). 1e. Wear long sleeved clothes treated with Permethrin, apply insect repellant containing DEET to exposed skin, and inspect clothes and skin for ticks during and after work. 1e. Apply sunscreen (SPF 15+) if exposure to sun for 30 minutes or more is expected.
	1f. EXPOSURE: Weather related injuries.	1f. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, nausea, rapid and shallow breathing). Take breaks in cool places and hydrate as needed. 1f. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks in warm areas as needed. 1f. Wear clothing appropriate for weather and temperature conditions (e.g., rain jackets, snow pants, multiple layers). 1f. If lightning is observed, wait 30 minutes in a sheltered location (car is acceptable) before resuming work.
	1g. EXPOSURE: Personal injury from noise hazards.	1g. Wear hearing protection if sound levels exceed 85 dBA (if you must raise your voice for normal conversation).

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-019**	DATE: 01/13/2022	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Reconnaissance**	WORK ACTIVITY (Description) **Site Walk and Inspection**	
DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Sara Barrientos	Project Geologist	Brian Hobbs	Corporate Health and Safety Director
Tim Unalp	SHSO	Joe Duminuco	Executive Vice President
		Ray Greenidge	Sr. Compliance Manager
REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT			
☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION: ear plugs as necessary ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: High-visibility vest or high-vis outerwear	☒ GLOVES: Leather/cut-resistant/chemical resistant ☒ OTHER: Tyvek and rubber boots as necessary, dust mask as necessary
REQUIRED AND / OR RECOMMENDED EQUIPMENT			
Required Equipment: Site map, emergency contact list, documentation of urgent care/hospital routes and / or guide familiar with Site, operating cell phone or walkie-talkie if Site allows, and bug spray.			
Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.			
EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.			
SITE SECURITY: Prior to site inspection verify appropriate method to address Site Security concerns as it relates to potential criminal activity, homeless population, and/or isolation concerns. Work with the Project Principal and/or Project Manager to address appropriately.			

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Check in with Site contact.	**1a. CONTACT/EXPOSURE/FALL:** Personal injury caused by lack of awareness of site-specific hazards.	1a. Inquire about hazards and other activities taking place at the Site. 1a. Inform Site contact of work scope, timeline and location(s). 1a. Discuss emergency evacuation procedures and muster points with Site contact.
2. Traversing the Site	**2a. CONTACT:** Property damage and personal injury caused by obstructions/vehicles or unauthorized personnel at remote Sites.	2a. All equipment must be stowed and secured prior to moving. 2a. Maintain speed limit as posted on-site. 2a. When possible, drive on established roadways. 2a. Yield to all pedestrians. 2a. Use pull-through spots or back into parking spots. 2a. Don high visibility clothing/safety vest. If working at remote Site, add orange accessories during hunting season.
	2b. FALL: Uneven terrain and weather conditions. Overgrown shrubs and vines. Equipment in the work zone.	2b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 2b. When possible, use established pathways and walk on stable, secure ground. 2b. Communicate traversing hazards with others.
	2c. OVEREXERTION: Muscle strain while carrying equipment.	2c. When carrying equipment to/from work area, use proper lifting techniques; keep back straight, lift with legs, keep load close to body, never reach with a load. Ensure that loads are balanced to reduce the potential for muscle strain. Use the buddy system or mechanical means to maneuver items heavier than 50-lb. If necessary, make multiple trips to carry equipment.
	2d. EXPOSURE: Biological hazards – ticks; bees/wasps; poison ivy; insects; (Ticks are most active any time the temperature is above freezing, typically from March to November.)	2d. Inspect area to avoid contact with biological hazards. 2d. Ticks: • Treat outer clothing including pants, shirts, socks, boots and hats the evening before with Permethrin (allowing at least two hours before use). • Apply DEET to exposed skin before travelling to the Site and reapply after two hours. • Check for ticks during and after work. 2d. Bees: • Use bee spray as appropriate to deter/eliminate bees.

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		• Protect exposed skin with insect repellent. 2d. Poison Ivy: • Identify areas of poison ivy and spray with weed killer. Don Tyvek and rubber boots while traversing poison ivy areas. • If skin contacts poison ivy, wash skin thoroughly with soap and water.
	2e. EXPOSURE: Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	2e. Wear sunscreen with SPF 15 or greater on exposed skin whenever 30 minutes or more of sun exposure is expected. 2e. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 2e. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 2e. Wear appropriate rain gear as needed. 2e. Take frequent breaks if tired, wet, or cold/hot. Drink water. 2e. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
3. Walking near heavy equipment and machinery.	**3a. CONTACT:** Personal injury from Site and roadway traffic. Personal injury from flying debris	3a. See 2a. 3a. Maintain an exclusion zone of at least 10'-25' feet from all engaged equipment. 3a. Keep body parts out of the line-of-fire of pinch points. 3a. Wear appropriate PPE always.
	3b. OVEREXERTION: Personal injury from lifting/moving/rotating equipment.	3b. See 2c.
	3c. EXPOSURE: Hearing damage from noise generating equipment/processes. Inhalation/exposure to hazardous vapors and or dust.	3c. Wear hearing protection if >85 dBA. (i.e. noise levels which require you to raise your voice to communicate) 3c. Always wear leather gloves when handling any tools or equipment. 3c. Always wear appropriate PPE based off chemicals present.
	3d. EXPOSURE: Working in a remote area.	3d. Use the "buddy system" whenever possible. If working alone, contact PM upon arrival/departure, as well as during work activities prior to commencing work if applicable. 3d. Always carry a communication device (i.e., cell phone, walkie-talkie) or directional (i.e., map, compass, etc.) when traversing remote areas. 3d. If available, follow Lone Worker Protocol/Procedure.
4. Working in adverse weather conditions.	**4a. EXPOSURE:** Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	4a. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 4a. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 4a. Wear appropriate rain gear as needed. 4a. Take frequent breaks if tired, wet, or cold/hot. Drink water. 4a. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
5. Departing Site.	**5a. EXPOSURE:** Exposure to unnecessary hazards should personnel believe Roux is on-Site during an emergency and conduct a search.	5a. Sign out or notify Site contact and Roux Project Manager of your departure.

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JOB SAFETYANALYSIS **Ctrl. No. GEN-020**	DATE: 01/13/2022	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **GENERIC**	WORK TYPE: **Gauging & Sampling**	WORK ACTIVITY (Description): **Soil Sampling**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
MaryBeth Lyons	Project Scientist	Brian Hobbs	CHSD
Tim Unalp	SHSO	Ray Greenidge	Sr. Compliance Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST
☒ HARD HAT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES
☒ FLAME RESISTANT CLOTHING (as needed)

☐ GOGGLES
☐ FACE SHIELD:
☒ HEARING PROTECTION: (as needed)
☒ SAFETY SHOES: Composite-toe or steel toe boots

☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing

☒ GLOVES: Leather, Nitrile and cut resistant
☒ OTHER: Insect repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Recommended Equipment: 42” traffic cones, caution tape, trowel

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs.

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Secure location	**1a. CONTACT:** Personnel and vehicular traffic may enter the work area.	1a. If in an area with foot or vehicle traffic, delineate the work area with 42” traffic cones and/or caution tape to prevent exposure to traffic and inform others of work activity. 1a. Wear reflective vest and/or high visibility clothing. 1a. Face the direction of any vehicular traffic. Position vehicle to protect worker from traffic. 1a. Communicate work activity with adjacent work areas.
	1b. FALL: Tripping/falling due to uneven terrain or entry/exit from excavations.	1b. Inspect pathways and work area for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions. 1b. Use established pathways and walk on stable, secure ground. 1b. Stage equipment and tools in a convenient, stable, and orderly manner. Store equipment at lowest potential energy. 1b. Roux employees should stay 5 feet from in-progress excavations and trenches. Should entry to an excavation be required (when stabilization is complete), ladders must be employed for steep embankments, excavations, pits, and trenches.
	1c. EXPOSURE: Exposure to sun and excessive heat, possibly causing sunburn, heat exhaustion or heat stroke. Exposure to cold temperatures possibly causing cold stress. Skin burn as a result of fire, if applicable. Exposure to explosive vapors due to tank farm operations. Exposure to airborne dust due to high wind speeds. Biological hazards - ticks, bees/wasps, poison ivy, thorns, insects, etc.	1c. Wear sunscreen with an SPF 15 or greater whenever 30 minutes or more of exposure is expected. 1c. Use a tent to shade the work area from direct sunlight particularly when warm temperatures are expected. 1c. Be aware of the location of all Site personnel. 1c. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). 1c. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). 1c. Take breaks for rest and water as necessary. Move to an area that is well shaded or a climate controlled area (i.e., car, site trailer, etc.). 1c. No open flames/heat sources. 1c. Conduct air monitoring and ensure that harmul vapor concentrations are within the levels detailed in the Site Specific HASP. Follow procedures detailed in HASP for exceedances. 1c. Flame retardant clothing must be worn when specified by Site policy. 1c. Cell phones should be disabled when specified by Site policy. 1c. Pre-treat field clothing with Permethrin prior to site visit to kill ticks and insects. 1c. Wear long sleeved shirts and tuck in (or tape) pant legs into socks or boots to prevent ticks from reaching skin. 1c. Spray insect repellant containing DEET on exposed skin when working in overgrown areas of the Site. 1c. Inspect area to avoid contact with biological hazards. 1c. Wear cut-resistant gloves when handling branches, shrubs, etc. that may lie within the walking path. 1c. Wear spoggles if the average wind speeds are above 15 mph. 1c. Personnel shall examine themselves and co-worker’s outer clothing for ticks periodically when onsite. 1c. If skin comes in contact with poison ivy, wash skin thoroughly with soap and water. If rash persists after washing, immediately notify your supervisor, the OM and OHSM for possible consultation with a physician at an approved Occupational Health Clinic.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
2. Collect Soil Sample	**2a. CONTACT:** Personal injury from pinch points, cuts, and abrasions from sampling equipment tools, and material within soil sample. Personal injury from contact with moving equipment while sampling. Personal injury from contact with glass sample jars.	2a. Wear cut-resistant (i.e., Kevlar) gloves under chemical-resistant (nitrile) disposable gloves when handling soil samples and sampling jars. 2a. Where possible, use trowel or equivalent tool to avoid contact with soil. 2a. If sampling from bucket of heavy equipment, ensure all equipment is off and operator utilizes the “show me your hands” policy. 2a. See 1a.
	2b. EXPOSURE: Exposure to contamination (impacted soil) and/or lab preservatives.	2b. Wear chemical-resistant (nitrile) disposable gloves over cut resistant gloves to protect hands when handling samples; use containment material or plastic sheeting to protect surrounding areas. 2b. Wear safety glasses to protect eyes from dust or air-borne contaminants that may results from disturbing the soil. 2b. Where possible, remain upgradient from sample location if collecting soil sample from stockpile, drill rig, etc. to avoid breathing contaminant vapors, if they are present. 2b. When collecting soil sample from hand auger, put large zip lock bag over entire auger to prevent spillage of soil on to the ground. 2b. Open sample jars slowly and fill carefully to avoid contact with preservatives.
	2c. EXERTION: Exertion due to repetitive motion and ergonomics.	2c. Utilize a table or raised surface for soil sampling if multiple soil samples are going to be taken to minimize repetitive bending motion.
3. Decontaminate equipment	**3a. EXPOSURE/CONTACT:** Contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated vapors and/or soil).	3a. Wear chemical-resistant (nitrile) disposable gloves and safety glasses. 3a. Use an absorbent pad to clean spills. 3a. Properly dispose of used materials/PPE in provided drums in designated drum storage area. 3a. Remain upwind of sample and avoid breathing contaminant vapors, if they are present.
	3b. EXPOSURE: Chemicals in cleaning solution including ammonia.	3b. Wear chemical-resistant (nitrile) disposable gloves and safety glasses. 3b. Work on the upwind side of decontamination area. 3b. Use an absorbent pad to clean spills. 3b. Properly dispose of used materials/PPE in provided drums in designated drum storage area. Ensure that all drums are properly labeled and secured.

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JOB SAFETY ANALYSIS **Ctrl. No. GEN-029**	DATE: 4/11/2023	☐ NEW ☒ REVISED	PAGE 1 of 2
JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Preclearing/Sampling**	WORK ACTIVITY (Description) **Hand Augering**	
DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Sean Owens	Senior Health & Safety Specialist	Brian Hobbs	Corporate Health & Safety Director

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Long sleeve high visibility clothing	☒ GLOVES: Cut Resistant / Leather / Nitrile / Chemical resistant ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Hand Auger Tools (buckets, rods), 5-gallon buckets, hand tools (hammer, etc)

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Drive/walk to hand clearing/hand augering location	**1a. CONTACT:** Property damage and personal injury caused by obstructions/vehicles	1a. Maintain speed limit on-site. 1a. All equipment must be stowed and secured prior to moving. 1a. Drive on established roadways. 1a. Do not back up vehicle without spotter where visibility is limited; use pull-through spots or back into parking spots; use an audible signal (horn/back-up alarm) when backing up vehicles.1c.
	1b. FALL: Personal injury from tripping/falling due to uneven terrain, weather conditions, and materials/equipment stored at portions of the Site	1b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 1b. Do not climb over stored materials/equipment; walk around. Use established pathways and walk on stable, secure ground. 1b. Use established ramp when descending into/ascending from impoundment areas. 1b. Keep tools and equipment in a designated area. When not in use, tools and equipment must be returned to their proper storage location. Keep work area clear of obstructions.
	1c. EXERTION: Muscle strain/exhaustion while carrying equipment (i.e., hand auger, post-hole digger, shovel, pry bar)	1c. When carrying equipment to/from work area, use proper lifting techniques; keep back straight, lift with legs, keep load close to body, never reach with a load. Ensure that loads are balanced to reduce the potential for muscle strain. Use mechanical assistance or make multiple trips to carry equipment.
	1d. EXPOSURE: Exposure to sun, possibly causing sunburn Biological hazards - bees/wasps, poison oak, thorns, insects, etc.	1d. Wear sunscreen with an SPF of at least 15 whenever 30 minutes or more of exposure is expected. 1d. Inspect area to avoid contact with biological hazards. 1d. Wear cut resistant gloves when handling branches, shrubs, etc. that may lie within the walking path. 1d. Avoid any areas onsite that have poison oak.
2. Secure location	**2a. CONTACT:** Personnel and vehicular traffic may enter the work area.	2a. Delineate the work area with traffic cones and/or caution tape to prevent exposure to traffic and inform others of work activity. 2a. Wear reflective vest and/or fluorescent clothing. 2a. Face the direction of vehicular traffic. Position vehicle to protect worker from traffic. 2a. Communicate work activity with adjacent work areas.
	2b. FALL: Tripping/falling due to uneven terrain, and materials /equipment stored within the work area	2b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment to the impoundments. 2b. Equipment and tools will be staged in a convenient, stable, and orderly manner. 2b. Equipment and tools will be stored at the lowest point of potential energy and out of the walkway and immediate work area (i.e. tools should not be propped against walls or nearby equipment or vehicles). 2b. Equipment and tools that are not anticipated to be used will be returned to an appropriate storage area that is out of the immediate work area.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Verify pre-clearance protocol; review completed Subsurface Utility Checklist and utility verification site walkthrough.	**3a. ENERGY SOURCE:** Underground utility damage; property damage; personal injury	3a. Confirm that "Call Before You Dig" and local utility companies were contacted prior to hand augering. 3a. Walk the Site to evaluate utility markings and review maps.
4. Augering/advancing borehole	**4a. EXPOSURE:** Contaminated soil/water/vapor	4a. Monitor breathing zone with a PID when VOCs area concern. If vapors sustain > 5 ppm, upgrade PPE as per HASP. 4a. Wear chemical-resistant disposable gloves and safety glasses when handling impacted materials. 4a. Place excavated soil on plastic sheeting and store soil waste in designated area. 4a. Work on the upwind side of the boring.
	4b. EXERTION: Muscle strain from lifting, bending, repetitive motion.	4b. Body positioning and rotating with the auger to reduce strain. Don't twist back.
	4c. CAUGHT: Personal injury as a result of jewelry/loose clothing caught on equipment, well covers, machinery, hand auger, pry bar etc..	4c. No form of jewelry should be worn while on-site. 4c. Clothing must be appropriately sized so it is not loose fitting.
	4d. CONTACT/CAUGHT: Pinch points, abrasions	4d. Keep head and upper body clear when lifting hand auger, pry bar/post-hole digger. Ensure to not be overly aggressive when using pry bar. 4d. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body.
5. Lithologic observation and soil sampling	**5a. EXPOSURE:** Contact with contamination (impacted soil and/or lab preservatives)	5a. Wear chemical-resistant disposable gloves to protect hands when handling samples; wear safety glasses when handling any preservatives; use containment material or plastic sheeting to protect surrounding areas. 5a. When collecting soil sample from hand auger, put large zip lock bag over entire auger to prevent spillage of soil on to the ground. 5a. Open sample jars slowly and fill carefully to avoid contact with preservatives.
6. Decontaminate equipment	**6a. EXPOSURE:** Contact with contamination (impacted soil and/or lab preservatives, decontamination solution)	6a. Wear chemical-resistant disposable gloves and safety glasses. 6a. Use an absorbent pad to clean spills. 6a. Properly dispose of used materials/PPE trash bags.
	6b. CONTACT/CAUGHT: pinch points and cuts/abrasions	6b. Keep fingers/hands out of pinch points when dis-assembling hand auger during decontamination.

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JOB SAFETY ANALYSIS Ctrl. No. GEN-013	DATE 1/4/2018	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE: **Gauging and Sampling**	WORK ACTIVITY (Description): **Gauging and Sampling**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Brandon Tufano	Staff Geologist	Brian Hobbs	Senior Health & Safety Manager
		Joe Gentile	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☒ LIFE VEST
☒ HARD HAT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES

☐ GOGGLES
☐ FACE SHIELD
☐ HEARING PROTECTION
☒ SAFETY SHOES: Composite-toe or steel toe boots

☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing

☒ GLOVES: Leather, Nitrile and cut resistant
☒ OTHER: Knee pads, Insect Repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

42-inch Safety Cones, Caution Tape, Interface Probe and/or Water Level Meter, 20-lb., Type ABC Fire Extinguisher, Buckets. Tools as needed: Socket Wrench, Screw Driver, Crow Bar, Mallet, and Wire Brush.

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Mobilization to monitoring well(s).	**1a. FALL:** Personal injury from slip/trip/fall due to uneven terrain and/or obstructions.	1a. Inspect pathway and plan for most suitable designated pathway prior to mobilization. 1a. Use established pathways, walk and/or drive on stable, secure ground and avoid steep hills or uneven terrain. 1a. If working near open water with an unguarded edge, wear life vest.
	1b. CONTACT: With traffic/third parties.	1b. Identify potential traffic sources and delineate work area with 42-inch traffic safety cones. Position vehicle to protect against oncoming traffic. Use caution tape to provide a more visible delineation of the work area if necessary. 1b. Wear appropriate PPE including high visibility clothing or reflective vest. 1b. Face traffic, maintain eye contact with oncoming vehicles, and establish a safe exit route.
	1c. EXERTION: Muscle strain from lifting equipment	1c. Use proper lifting techniques when handling/moving equipment; bend knees and keep back straight. 4c. Use mechanical assistance or team lifting techniques when equipment is 50 lbs. or heavier. 4c. Make multiple trips to carry equipment.
	1d. EXPOSURE: To biological hazards.	1d. Inspect work area for bees and insects. 1d. Use insect/tick repellent as necessary.
2. Open/close well.	**2a. EXERTION:** Muscle strain.	2a. Use proper lifting techniques; keep back straight, lift with legs and bend knees when reaching to open/close well.
	2b. CAUGHT: Pinch/crush points associated with removing/replacing manholes and working with hand tools.	2b. Wear leather gloves or cut resistant gloves when working with well cover and hand tools. 2b. Use proper tools (ratchet and pry bar for well cover) and inspect before use. 2b. Do not put fingers under well cover.
	2c. CAUGHT: Pinch points associated with placing J-plug back onto PVC pipe.	2c. See 2b. 2c. Keep fingers out of line-of-fire when securing cap.
	2d. EXPOSURE: To potential hazardous vapors.	2d. No open flames/heat sources. 2d. To minimize exposure to vapors, allow well to vent after opening it and before sampling activities begin. 2d. Stand up-wind, if possible, to avoid inhaling vapors.
3. Gauge well.	**3a. CONTACT:** With contamination (e.g. contaminated groundwater).	3a. Wear chemical-resistant disposable gloves (over cut-resistant gloves) and safety glasses when gauging well. 3a. Insert and remove probe slowly to avoid splashing. 3a. Use an absorbent pad to clean probe.
	3b. CONTACT: With traffic.	3b. See 1b.

[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
4. Purge and sample well	**4a. EXPOSURE/CONTACT:** To contamination (e.g., SPH, contaminated groundwater, vapors) and/or sample preservatives.	4a. Open and fill sample jars slowly to avoid splashing and contact with preservatives. 4a. Wear cut-resistant gloves and chemical-resistant disposable gloves when sampling. 4a. Fill sample containers over purge container to avoid spilling water onto the ground. 4a. Use an absorbent pad to clean spills. 4a. When using a bailer to purge a well, pull the bailer slowly from the well to avoid splash hazards. 4a. When sampling or purging the water using a bailer, pour out water slowly to reduce the potential for splash hazards with groundwater. 4a. When using a tubing valve always remove the valve slowly after sample collection to release any pressure and avoid pressurized splash hazards. 4a. When collecting a groundwater sample always point sampling apparatus (tubing, bailer, etc.) away from face and body.
	4b. CONTACT: Personal injury from cuts, abrasions, or punctures by glassware or sharp objects.	4b. To avoid spills or breakage, place sample ware on even surface. 4b. Do not over tighten caps on glass sample ware. 4b. Wear chemical-resistant nitrile disposable gloves over cut-resistant (i.e., Kevlar) gloves when sampling and handling glassware (i.e., VOA vials) or when using cutting tools.
	4c. EXERTION: Muscle strain while carrying equipment.	4c. Use proper lifting techniques when handling/moving equipment, bend knees and keep back straight. 4c. Use mechanical assistance or team lifting techniques when equipment is 50 lbs. or heavier. 4c. Make multiple trips to carry equipment.
	4d. CONTACT: With traffic.	4d. See 1b.
	4e. CONTACT: Pinch points with groundwater pump components (i.e., wheel, line, clamps).	4e. Wear leather gloves when working with groundwater pumps. 4e. Never place hands on or near pinch points such as the wheel, clamps or other moving parts during pump operations. 4e. Use the correct mechanisms, such as a pump reel, to lower pump into well. 4e. Never attempt to manually stop any moving part of equipment including hose reels and/or tubing.
	4f. EXERTION: Muscle strain from repetitive motion of bailing and sampling a well.	4f. See 4c. 4f. Include a stretch break when repetitive motions are part of the task.
5. Management of purge water.	**5a. EXPOSURE/CONTACT:** To contamination (e.g., SPH, contaminated groundwater, vapors).	5a. Do not overfill container and pour liquids slowly so that they do not splash. 5a. Properly dispose of used materials/PPE in appropriate container in designated storage area.
	5b. EXERTION: Muscle strain from lifting/carrying and moving containers.	5b. Use proper lifting techniques when lifting / carrying or moving container(s) (see 4c.). 5b. Do not overfill container(s).
6. Decontaminate equipment.	**6a. EXPOSURE/CONTACT:** To contamination (e.g., SPH, contaminated groundwater, vapors).	6a. Work on the upwind side, where possible, of decon area. 6a. Wear chemical-resistant disposable gloves and safety glasses. 6a. Use an absorbent pad to clean spills.
	6b. CAUGHT: Pinch points associated with handling hand tools	6b. See 2b. 6b. Inspect hand tools for sharp edges before decontaminating.

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-015**	DATE: 1/4/2018	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Mobilization/Demobilization**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Rebecca Lowy	Staff Assistant Geologist	Brian Hobbs	Senior Health & Safety Manager
Tally Sodre	OHSM	Joe Gentile	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION (as needed) ☒ SAFETY SHOES: Steel Toe or composite toe	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest of high-visibility clothing; long sleeve shirt; long pants	☒ GLOVES: Leather, nitrile, and cut resistant (as needed) ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: None

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around equipment in use..

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Mobilize/demobilize and establish work area	**1a. FALL:** Slip/trips/falls from obstructions, uneven terrain, weather conditions, heavy loads, and/or poor housekeeping.	1a. Use 3 points-of-contact/ensure secure footing when entering and exiting vehicle. 1a. Inspect walking path for uneven terrain, steep hills, obstructions, and/or weather-related hazards (i.e., ice, snow, and puddles) prior to mobilizing equipment. Use established pathways. Walk on stable/secure ground. 1a. Do not climb over stored materials/equipment; walk around. Practice good housekeeping; organize and store equipment neatly in one area at its lowest potential energy. 1a. Wear boots with adequate treads. 1a. Delineate unsafe areas with 42” cones, caution tape and/or flagging.
	1b. CONTACT: Personal injury and/or property damage caused by being struck by Site traffic or equipment used in Site activities.	1b. Observe and maintain the posted speed limits. 1b. When first arriving onsite, park vehicles in designated parking space and/or out of the way locations. Use parking brake on all vehicles and tire chocks on work trucks and trailers. 1b. Check in with Site Manager/Supervisor to ensure coordination with other Site activities and to discuss any special hazards. Ensure that short-service employees (SSE) are identified. 1b. Identify potential traffic sources. 1b. Wear PPE including high visibility clothing or reflective vest. 1b. Use a spotter while moving work vehicles; plan ahead to avoid backing whenever possible. 1b. Maintain a minimum 10’ exclusion zone when vehicles are in motion. When backing up truck rig with an attached trailer use a second spotter if there is tight clearance simultaneously on multiple sides of the equipment or if turning angles limit driver-to-spotter visibility. 1b. Delineate work area with 42” cones, flags, caution tape, and/or other barriers. 1b. Position “Work Area” signs at Site entrances, if possible, or at either side of work area.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
		1b. Position largest vehicle to protect against oncoming traffic. 1b. Face traffic, maintain eye contact with oncoming vehicles, use a spotter, and establish a safe exit route. 1b. Observe potential overhead and ground surface features that may interfere with moving equipment. Clear the path of physical hazards prior to initiating mobilization.
	1c. CAUGHT: Personal injury from pinch points and being in line-of-fire of vehicle and/or equipment.	1c. Make sure driver has engaged parking brake and placed wheel chocks in a position to prevent movement. Be sure that vehicle is parked in front/down gradient (positioned to best block oncoming traffic) of work area. 1c. Wear leather gloves when handling any tools or equipment. Wear cut-resistant gloves (Kevlar or similar) when handling sharp objects/cutting tools/glass. 1c. Keep body parts away from line-of-fire of equipment. 1c. Always carry tools by the handles and/or designated carrier. Ensure sharp-edged tools are sheathed/secure. 1c. Remove any loose jewelry. Avoid wearing loose clothing and/or ensure loose clothing is secure. 1c. Secure all items on the equipment, tighten up any items or features that have potential to shift or break during mobilization.
	1d. OVEREXERTION: Muscle strains while lifting/carrying equipment.	1d. Use body positioning and lifting techniques that avoid muscle strain; keep back straight, lift with legs, turn with whole body, keep load close to body, and never reach with a load. 1d. Ensure that loads are balanced. Use assistance (mechanical or additional person) to carry equipment that is either unwieldy or over 50 lbs.
	1e. EXPOSURE: Personal injury from exposure to biological and environmental hazards.	1e. Inspect area to avoid contact with biological hazards (i.e. poisonous plants, stinging insects, ticks, etc.). 1e. Wear long sleeved clothes treated with Permethrin, apply insect repellant containing DEET to exposed skin, and inspect clothes and skin for ticks during and after work. 1e. Apply sunscreen (SPF 15+) if exposure to sun for 30 minutes or more is expected.
	1f. EXPOSURE: Weather related injuries.	1f. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, nausea, rapid and shallow breathing). Take breaks in cool places and hydrate as needed. 1f. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks in warm areas as needed. 1f. Wear clothing appropriate for weather and temperature conditions (e.g., rain jackets, snow pants, multiple layers). 1f. If lightning is observed, wait 30 minutes in a sheltered location (car is acceptable) before resuming work.
	1g. EXPOSURE: Personal injury from noise hazards.	1g. Wear hearing protection if sound levels exceed 85 dBA (if you must raise your voice for normal conversation).

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

APPENDIX C

Safety Data Sheets (SDSs) for Chemicals Used

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: Alconox

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer	**Supplier**
Alconox, Inc. 30 Glenn Street White Plains, NY 10603 1-914-948-4040	Not Applicable

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:

Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Additional information: None.

Hazard description
Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:
The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 Additional Information : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:
Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

8 Exposure controls/personal protection

8.1 Control parameters :

7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3.

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:

Wash hands before breaks and at the end of work.

Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density**:	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or not available.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity:**	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 **Reactivity** : None

10.2 **Chemical stability** : None

10.3 **Possibility hazardous reactions** : None

10.4 **Conditions to avoid** : None

10.5 **Incompatible materials** : None

10.6 **Hazardous decomposition products** : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: None
ADR, ADN, DOT, IMDG, IATA

14.2 UN Proper shipping name: None
ADR, ADN, DOT, IMDG, IATA

14.3 Transport hazard classes:
ADR, ADN, DOT, IMDG, IATA

Class:	None
Label:	None
LTD. QTY:	None

US DOT
Limited Quantity Exception: None

Bulk:	**Non Bulk:**
RQ (if applicable): None	**RQ (if applicable):** None
Proper shipping Name: None	**Proper shipping Name:** None
Hazard Class: None	**Hazard Class:** None
Packing Group: None	**Packing Group:** None
Marine Pollutant (if applicable): No additional information.	**Marine Pollutant (if applicable):** No additional information.

Comments: None	**Comments:** None
14.4 Packing group: ADR, ADN, DOT, IMDG, IATA	None
14.5 Environmental hazards :	None
14.6 Special precautions for user:	None
Danger code (Kemler):	None
EMS number:	None
Segregation groups:	None
14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.	
14.8 Transport/Additional information:	
Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

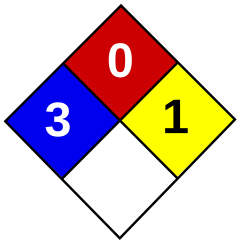
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

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 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.

NFPA: 1-0-0

HMIS: 1-0-0



Health	3
Fire	0
Reactivity	1
Personal Protection	

Material Safety Data Sheet

Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

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
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

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. Cold water may be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

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. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, 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 immediately.

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: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. 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:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

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. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

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:
CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of ingestion, . Hazardous in case of eye contact (corrosive), of inhalation (lung corrosive).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

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 products of degradation are less toxic than the product itself.

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 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 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-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 1

Personal Protection:

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 1

Specific hazard:

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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SAFETY DATA SHEET

Isobutylene

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier : Isobutylene

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

Product type : Gas.

Product use : Synthetic/Analytical chemistry.

Synonym : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

SDS # : 001031

Supplier's details :
Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture :
FLAMMABLE GASES - Category 1
GASES UNDER PRESSURE - Liquefied gas

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements :
Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May displace oxygen and cause rapid suffocation.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction. Always keep container in upright position. Approach suspected leak area with caution.

Prevention : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

Response : Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so.

Storage : Protect from sunlight. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : In addition to any other important health or physical hazards, this product may displace oxygen and cause rapid suffocation.

Section 3. Composition/information on ingredients

Substance/mixture : Substance

Chemical name : 2-methylpropene

Other means of identification : 1-Propene, 2-methyl-; Isobutene; Isobutylene; 1-Propene, 2-methyl- (isobutene); 1, 1-Dimethylethylene; Isopropylidenemethylene; iso-Butene; i-Butene; 2-Methylpropylene; 2-Methyl-2-propene; 2-Methyl-1-propene

Product code : 001031

CAS number/other identifiers

CAS number : 115-11-7

Ingredient name	%	CAS number
Isobutylene	100	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. To avoid the risk of static discharges and gas ignition, soak contaminated clothing thoroughly with water before removing it. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Section 4. First aid measures

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : Contains gas under pressure. Extremely flammable gas. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool. If involved in fire, shut off flow immediately if it can be done without risk. If this is impossible, withdraw from area and allow fire to burn. Fight fire from protected location or maximum possible distance. Eliminate all ignition sources if safe to do so.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : Accidental releases pose a serious fire or explosion hazard. No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment.

Large spill : Immediately contact emergency personnel. Stop leak if without risk. Use spark-proof tools and explosion-proof equipment. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid breathing gas. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
Use only non-sparking tools. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Eliminate all ignition sources. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F). Keep container tightly closed and sealed until ready for use. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Isobutylene	**ACGIH TLV (United States, 3/2017).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Section 8. Exposure controls/personal protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state	: Gas. [Compressed gas.]
Color	: Colorless.
Odor	: Characteristic.
Odor threshold	: Not available.
pH	: Not available.
Melting point	: -140.7°C (-221.3°F)
Boiling point	: -6.9°C (19.6°F)
Critical temperature	: 144.75°C (292.6°F)
Flash point	: Closed cup: -76.1°C (-105°F)
Evaporation rate	: Not available.
Flammability (solid, gas)	: Extremely flammable in the presence of the following materials or conditions: open flames, sparks and static discharge and oxidizing materials.
Lower and upper explosive (flammable) limits	: Lower: 1.8% Upper: 9.6%
Vapor pressure	: 24.3 (psig)
Vapor density	: 1.94 (Air = 1)
Specific Volume (ft ^{3}/lb)	: 6.6845
Gas Density (lb/ft ^{3})	: 0.1496 (25°C / 77 to °F)
Relative density	: Not applicable.
Solubility	: Not available.
Solubility in water	: 0.26 g/l
Partition coefficient: n-octanol/water	: 2.34
Auto-ignition temperature	: 465°C (869°F)
Decomposition temperature	: Not available.
Viscosity	: Not applicable.
Flow time (ISO 2431)	: Not available.
Molecular weight	: 56.12 g/mole

Aerosol product

Heat of combustion : -45029034 J/kg

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition.

Incompatible materials : Oxidizers

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Hazardous polymerization : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Section 11. Toxicological information

Inhalation : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$\mathrm{LogP_{ow}}$	BCF	Potential
Isobutylene	2.34	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Section 12. Ecological information

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	**TDG**	**Mexico**	**IMDG**	**IATA**
UN number	UN1055	UN1055	UN1055	UN1055	UN1055
UN proper shipping name	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE	ISOBUTYLENE
Transport hazard class(es)	2.1 	2.1 	2.1 	2.1 	2.1 
Packing group	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Additional information

DOT Classification : **Limited quantity** Yes.
Quantity limitation Passenger aircraft/rail: Forbidden. Cargo aircraft: 150 kg.
Special provisions 19, T50

TDG Classification : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2).
Explosive Limit and Limited Quantity Index 0.125
ERAP Index 3000
Passenger Carrying Ship Index Forbidden
Passenger Carrying Road or Rail Index Forbidden
Special provisions 29

IATA : **Quantity limitation** Passenger and Cargo Aircraft: Forbidden. Cargo Aircraft Only: 150 kg.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

Clean Air Act (CAA) 112 regulated flammable substances: Isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

State regulations

Massachusetts : This material is listed.

New York : This material is not listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: This material is listed or exempted.
Japan inventory (ISHL): Not determined.

Malaysia : Not determined.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Section 15. Regulatory information

Taiwan : This material is listed or exempted.
Thailand : Not determined.
Turkey : Not determined.
United States : This material is listed or exempted.
Viet Nam : Not determined.

Section 16. Other information

Hazardous Material Information System (U.S.A.)

Health	/	1
Flammability		4
Physical hazards		3

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

National Fire Protection Association (U.S.A.)

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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Liquefied gas	Expert judgment Expert judgment

History

Date of printing : 5/10/2018
Date of issue/Date of revision : 5/10/2018
Date of previous issue : 7/11/2016
Version : 0.02

Key to abbreviations :
ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973

Section 16. Other information

as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

APPENDIX D

COVID-19 Interim Health and Safety Guidance

COVID-19 INTERIM HEALTH AND SAFETY GUIDANCE

CORPORATE HEALTH AND SAFETY MANAGER	:	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	:	**03/2020**
REVISION DATE	:	**01/10/2022**
REVISION NUMBER	:	**8**

TABLE OF CONTENTS

APPENDICES

1. PURPOSE

This guidance has been implemented to establish work practices, administrative procedures, and engineering controls to minimize potential exposure to SARS-CoV-2, the virus that causes COVID-19. The following guidance has been developed based on local, state and federal recommendations/requirements regarding COVID-19. The purpose of this document is to supplement existing site-specific Health and Safety Plans (HASPs) and provide interim health and safety guidance to minimize potential exposure to SARS-CoV-2. Should additional scientific information or regulatory information change, this document shall be updated accordingly.

2. SCOPE AND APPLICABILITY

This guidance covers all Roux employees and the subcontractors that Roux oversees. Site specific HASPs shall be developed to incorporate elements of mitigative measures against COVID-19 exposure. If work cannot be carried out in compliance with this guidance, the project shall be further evaluated by the Project Principal (PP), Office Manager (OM), and Corporate Health and Safety Director (CHSD) prior to work authorization.

Roux subcontractors are required to review, comply with, and implement Roux's COVID-19 Interim Health and Safety Guidance while on Site. Subcontractors may implement additional preventative measures as they see fit. All work shall be conducted in a manner consistent with the federal, state, and local guidance as it relates to COVID-19.

3. BACKGROUND

What is COVID-19?

COVID-19 is a respiratory illness that can spread from person to person. The virus that causes COVID-19 is a novel coronavirus that was first identified during an investigation into an outbreak in Wuhan, China. This virus continues to spread internationally and within the United States. Multiple variants of the virus that causes COVID-19 are circulating globally. There are currently several vaccines which have been developed which are authorized, recommended and effective at protecting you from getting sick.

What are the symptoms of COVID-19?

Reported illnesses have ranged from mild symptoms to severe illness and death for confirmed COVID-19 cases. Symptoms may appear 2 to 14 days following exposure to the virus. People with these symptoms or combinations of symptoms may have COVID-19:

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

This list is not all possible symptoms. The CDC will continue to update this list as they learn more about the virus. For an updated symptom list please reference the [following link for CDC Symptoms of Coronavirus.]()

If someone develops emergency warning signs for COVID-19, they should be instructed to get medical attention immediately. Emergency warning signs can include those listed below; however, this list is not all inclusive. Please consult your medical provider for any other symptoms that are severe or concerning.

- Trouble breathing
- Persistent pain or pressure in the chest
- New confusion
- Inability to wake or stay awake
- Pale, gray, or blue-colored skin, lips, or nail beds, depending on skin tone

How does COVID-19 spread?[1]

Individuals who are within close contact (within 6 feet) of a person with COVID-19 or have direct contact with that person are at greatest risk of infection.

COVID-19 spreads in three main ways:

- Breathing in air when close to an infected person who is exhaling small droplets and particles that contain the virus.
- Having these small droplets and particles that contain virus land on the eyes, nose, or mouth, especially through splashes and sprays like a cough or sneeze.
- Touching eyes, nose, or mouth with hands that have the virus on them.

Transmission of SARS-CoV-2 from inhalation of virus in air farther than six feet from an infectious source can occur.

Some infections can be spread by exposure to virus in small droplets and particles that can linger in the air for minutes to hours. These viruses may be able to infect people who are further than 6 feet away from the person who is infected or after that person has left the space. This kind of spread is referred to as **airborne transmission** and is an important way that infections like tuberculosis, measles, and chicken pox are spread. Per published reports, factors that increase the risk of SARS-CoV-2 infection under these circumstances include:

- Enclosed spaces with inadequate ventilation or air handling within which the concentration of exhaled respiratory fluids, especially very fine droplets and aerosol particles, can build-up in the air space.
- Increased exhalation of respiratory fluids if the infectious person is engaged in physical exertion or raises their voice (e.g., exercising, shouting, singing).
- Prolonged exposure to these conditions, typically more than 15 minutes.

Spread from contact with contaminated surfaces or objects is less common.

Respiratory droplets can also land on surfaces and objects. It is possible that a person could get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or eyes. Spread from touching surfaces is not thought to be a common way that COVID-19 spreads.

4. TRAINING REQUIREMENTS

All employees with potential exposure to COVID-19 shall be provided training that incorporates COVID-19 exposure mitigation strategies, such as implementation of proper social distancing, personal hygiene (e.g., handwashing), as well as disinfection procedures, as outlined by CDC guidelines.

5. EXPOSURE RISK POTENTIAL

Worker risk of occupational exposure to COVID-19 can vary from very high, high, medium, or lower (caution) risk. This level of exposure is dependent on several factors, which can include industry type; need for contact within 6 feet of people known to be or suspected of being infected with COVID-19; density of work environment; and industrial setting (i.e., healthcare building, occupied interior work area, minimal ventilation).

Provided below is background risk level information taken from the U.S. Department of Labor Occupational Safety and Health Administration Guidance on preparing workplaces for COVID-19. Risk evaluations for each project shall be conducted by the PP and OM in consultation with the CHSD to ensure Roux employees and subcontractors remain within the lower exposure (caution) category. If it is identified there is a medium exposure risk or higher, further evaluation and mitigative measures shall be evaluated to reduce overall exposure risk prior to work authorization.

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[1] How COVID-19 Spreads https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html#edn1

Very High Exposure Risk (Activities not conducted by Roux)

Very high exposure risk includes occupations/work activities with high potential for exposure to known or suspected sources of COVID-19 during specific medical, postmortem, or laboratory procedures. This can include but is not limited to:

- Healthcare workers (e.g., doctors, nurses, dentists, paramedics, emergency medical technicians) performing aerosol-generating procedures (e.g., intubation, cough induction procedures, bronchoscopies, some dental procedures and exams, or invasive specimen collection) on known or suspected COVID-19 patients.
- Healthcare or laboratory personnel collecting or handling specimens from known or suspected COVID-19 patients (e.g., manipulating cultures from known or suspected COVID-19 patients).

High Exposure Risk (Activities not conducted by Roux)

High exposure risk occupations/work activities include exposure to known or suspected COVID-19 positive individuals. This can include but not limited to:

- Healthcare delivery and support staff (hospital staff who must enter patients' rooms) exposed to known or suspected COVID-19 patients.
- Medical transport workers (ambulance vehicle operators) moving known or suspected COVID-19 patients in enclosed vehicles.
- Mortuary workers involved in preparing bodies for burial or cremation of people known to have, or suspected of having, COVID-19 at the time of death.
- Those who have frequent or sustained contact with coworkers, including under close working conditions indoors or in poorly ventilated spaces in various types of industrial, manufacturing, agriculture, construction, and other critical infrastructure workplaces.
- Those who have frequent indoor or poorly ventilated contact with the general public, including workers in retail stores, grocery stores or supermarkets, pharmacies, transit and transportation operations, law enforcement and emergency response operations, restaurants, and bars.

Medium Exposure Risk

Medium exposure risk occupations/work activities include those that require frequent and/or close contact with (i.e., within 6 feet for a cumulative total of 15 minutes or more over a 24-hour period)) people who may be infected with COVID-19, but who are not known or suspected to be COVID-19 positive. For most of our worksites, it is assumed there is on-going community transmission for COVID-19. Therefore, workers who work at sites and may have contact with the general public, other contractors, high-population-density work environments (i.e., greater than 10 people) fall within medium exposure risk group category. This can include, but is not limited to, sampling events that require two or more workers to collect and log samples in close contact or work occurring in an interior space with limited ventilation and several workers present.

Lower Exposure Risk (Caution)

Lower exposure risk (caution) occupations/work activities are those that do not require close contact (within 6 feet for a cumulative total of 15 minutes or more over a 24-hour period) with other people. During these activities, there is limited contact (i.e., within 6 feet of) the general public or other workers. Workers in this category have minimal occupational contact with the public and other coworkers. This includes construction oversight that does not require close contact, sampling or gauging events performed by one worker and our remote workers as well as office workers who do not have frequent close contact with coworkers, clients, or the public.

6. CDC FULLY VACCINATED GUIDANCE

Vaccination is a vital tool to reduce the presence and severity of COVID-19 cases in the workplace and communities. Roux has recommended the vaccine for all employees. Should vaccines be required by local/state/client requirements Roux shall ensure our workforce shall comply with such requirement. Roux Human Resources shall collect information on vaccination status of employees who have been vaccinated to make informed decisions and ensure conformance with state/local requirements, as appropriate.

In general, employees shall be considered fully vaccinated:

- 2 weeks after their second dose in a 2-dose series, such as the Pfizer or Moderna vaccines, or
- 2 weeks after a single-dose vaccine, such as Johnson & Johnson's Janssen vaccine.

If you do not meet these requirements, regardless of age, you are not fully vaccinated and are asked to continue to take all precautions until you are fully vaccinated. CDC recommends that people remain up to date with their vaccines, which includes additional doses for individuals who are immunocompromised or booster doses at regular time points. Individuals who are moderately or severely immunocompromised should get an additional primary shot and a booster shot.

7. COVID-19 HEALTH SCREENING

7.1 Roux Employees

Depending on local/state/client requirements, Roux employees may self-attest to a COVID-19 Daily Health Questionnaire which is to be completed at home through a mobile application on scheduled workdays. The purpose of this program is to ensure business continuity as well as mitigate any potential exposure to our employees and others if it is determined employees are at-risk for contracting COVID-19. As part of this self-attestation, all employees are required to take their temperatures daily at home to confirm they do not have a fever (≥ 100.4). Employees who answer yes to any of these questions are instructed to contact their Office Manager and/or Department Head immediately and should not enter the office or go to a field site. Information shall be used to determine appropriate internal response in consultation with the Human Resources Director (HRD) and CHSD.

Below, you will find our COVID-19 Daily Health Questionnaire that all Roux employees are required to self-attest to **every scheduled workday by 9:30 AM.** If employees do not promptly fill out the questionnaire by the time listed above, there will be additional follow up by HR, H&S, and/or OMs.

According to the U.S. Centers for Disease Control and Prevention & the World Health Organization, COVID-19 Symptoms include:

- *Fever (≥100. 4°F) or chills*
- *Cough*
- *Shortness of breath or difficulty breathing*
- *Fatigue*
- *Muscle or body aches*
- *Headache*
- *New loss of taste or smell*
- *Sore throat*
- *Congestion or runny nose*
- *Nausea or vomiting*
- *Diarrhea*

Have you experienced any of the COVID-19 related symptoms noted above in the last 14 days? Please Note: We do not expect employees to answer "yes" to the symptoms question if these are symptoms you normally experience due to another condition or medication.

- *Yes*
- *No*

Have you been in close contact with someone who is suspected or confirmed to have COVID-19 or who is under investigation for COVID-19 within the last 14 days? * Close contact as defined by the CDC is being within 6 feet of someone who has COVID-19 for a cumulative total of 15 minutes or more over a 24-hour period.*

- *Yes*
- *No*

Have you traveled outside of the country, been on a cruise ship and/or traveled to areas within the United States which have state mandated travel restrictions in the last 14 days?

- *Yes*
- *No*

Have you tested positive for COVID-19 within the last 14 days?

- *Yes*
- *No*

7.2 Subcontractors

In an effort to mitigate the risk of transmission of COVID-19, Subcontractors who shall perform work onsite are required to attest to the fitness of their work crew on a daily basis. This requires each worker to self-assess by asking themselves the four questions listed in the section above and also contained within the Roux Subcontractor Work Crew COVID-19 Daily Health Attestation. If any crew member answers "Yes" to any of the questions, that worker is not to report to the field site and should seek proper medical advice in accordance with local, state and federal guidelines. In addition, the Sub-Contractor shall self-attest to vaccination status in order for the Field Team to ensure conformance with updated guidance for fully vaccinated individuals should state/local/client requirements allow. See Section 6. CDC Fully Vaccinated Guidance.

On a daily basis, the subcontractor supervisor must provide the Subcontractor Work Crew COVID-19 Daily Health Attestation complete with the names of all work crew fit to be on the Site for that day (i.e., who have answered "No" to all questions on the self-assessment) to Roux's Project Manager or Site Supervisor. The Subcontractor must notify Roux if there have been any "Yes" responses daily. Subcontractors shall not be required to provide the name or any other personal information of any employee who has answered "Yes" to any of the self-assessment questions, however, the Subcontractor should provide the date and times that the employee has been onsite in the prior 14 days. Records shall be maintained within the project files indicating health screening has been performed, records shall be retained for not less than 14 days following the date of submission. The Roux Subcontractor Work Crew COVID-19 Daily Health Check Attestation can be found within Appendix A.

8. SELF-ISOLATION & QUARANTINE

8.1 Self-Isolation

What if I am asked to self-isolate at home and when can I return from home isolation?

Depending on the situation, if you are COVID-19 positive or suspected to have COVID-19, employees may be required to self-isolate in their homes, as per CDC or local health department guidelines. Roux shall follow CDC guidance in areas where local/state requirements allow. The following table below outlines CDC isolation guidance.

Day 0 is your first day of symptoms or a positive viral test. Day 1 is the first full day after your symptoms developed or your test specimen was collected. If you have COVID-19 or have symptoms, isolate for at least 5 days.

IF YOU Tested positive for COVID-19 or have symptoms, regardless of vaccination status	**Stay home for at least 5 days** Stay home for 5 days and isolate from others in your home. Wear a well-fitted mask if you must be around others in your home.	**Ending isolation if you had symptoms** End isolation after 5 full days if you are fever-free for 24 hours (without the use of fever-reducing medication) and your symptoms are improving. **Ending isolation if you did NOT have symptoms** End isolation after at least 5 full days after your positive test. **If you were severely ill with COVID-19** You should isolate for at least 10 days. Consult your doctor before ending isolation.	**Take precautions until day 10** **Wear a mask** Wear a well-fitted mask for 10 full days any time you are around others inside your home or in public. Do not go to places where you are unable to wear a mask. **Avoid travel** **Avoid being around people who are at high risk**

8.2 Quarantine

Employees may be required to self-quarantine due to potential exposure with a suspected and/or confirmed COVID-19 positive individual as well as recent travel as per local/state guidelines. People in quarantine should stay home, separate themselves from others, monitor their health, and follow directions from their state or local health department.

8.2.1 Close Contact Quarantine

The following table below outlines CDC quarantine guidance. The date of your exposure is considered day 0. Day 1 is the first full day after your last contact with a person who has had COVID-19. Stay home and away from other people for at least 5 days.

IF YOU Were exposed to COVID-19 and are NOT up-to-date on COVID-19 vaccinations	**Quarantine for at least 5 days** **Stay home** Stay home and quarantine for at least 5 full days. Wear a well-fitted mask if you must be around others in your home. **Get tested** Even if you don't develop symptoms, get tested at least 5 days after you last had close contact with someone with COVID-19.	**After quarantine** **Watch for symptoms** Watch for symptoms until 10 days after you last had close contact with someone with COVID-19. **If you develop symptoms** Isolate immediately and get tested. Continue to stay home until you know the results. Wear a well-fitted mask around others.	**Take precautions until day 10** **Wear a mask** Wear a well-fitted mask for 10 full days any time you are around others inside your home or in public. Do not go to places where you are unable to wear a mask. **Avoid travel** **Avoid being around people who are at high risk**

IF YOU **Were exposed to COVID-19 and are up-to-date with vaccination OR had confirmed COVID-19 within the past 90 days (you tested positive using a viral test)**	**No quarantine** You do not need to stay home **unless** you develop symptoms. **Get tested** Even if you don't develop symptoms, it is recommended to get tested at least 5 days after you last had close contact with someone with COVID-19	**Watch for symptoms** Watch for symptoms until 10 days after you last had close contact with someone with COVID-19. **If you develop symptoms** Isolate immediately and get tested. Continue to stay home until you know the results. Wear a well-fitted mask around others.	**Take precautions until day 10** **Wear a mask** Wear a well-fitted mask for 10 full days any time you are around others inside your home or in public. Do not go to places where you are unable to wear a mask. **Avoid travel** **Avoid being around people who are at high risk**

8.2.2 Travel Related Quarantine/Testing

All travel out of state must be communicated with the OM and/or Department Head prior to departure. Please note, some federal/state/local entities require submissions of traveler health forms and potentially require additional testing for COVID-19. It is expected all Roux employees will comply with such federal/state/local travel requirements.

9. WORKPLACE CONTROLS

During the project planning phase, worksite evaluations shall be carried out by the PP and OM in consultation with the CHSD to determine risk exposure levels for work activities. If it is determined there is a high exposure risk level or higher, additional workplace controls shall be evaluated and implemented as required in addition to the basic infection prevention measures outlined below in Section 10. Additional workplace controls can include engineering controls (i.e., ventilation, physical barriers), administrative controls (i.e., minimizing contact between workers, rotating shifts, site specific training), and additional personal protective equipment (i.e., respiratory protection). If exposure risk cannot be mitigated, potential project postponement may be necessary at the discretion of the OM in consultation with the CHSD.

A Job Safety Analysis (JSA) has been developed and is provided in Appendix B, which summarizes and applies concepts within this guidance, including the infection prevention measures listed below. This JSA shall be required for all fieldwork in areas where there is community-based transmission of COVID-19.

10. INFECTION PREVENTION MEASURES

The following is basic infection prevention and personal hygiene practices which shall be implemented for all Roux field activities as well as in the office setting.

- ***Personal Hygiene***
  - Wash your hands often with soap and water for at least 20 seconds.
    - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% alcohol.
    - Key times to wash your hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
  - Do not touch your eyes, face, nose and mouth with unwashed hands.
  - Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow.
  - Throw potentially contaminated items (e.g., used tissues) in the trash.

- ***Avoid Close Contact/Secondary Contact with People and Potentially Contaminated Surfaces***
    - Apply appropriate social distance (6+ feet), as appropriate.
    - Do not work in areas with limited ventilation with other Site workers (e.g., small work trailer which lacks HVAC system).
    - Morning tailgate/safety meetings are recommended to occur outside or in well ventilated work trailers.
    - Contact your lab/equipment vendor to confirm equipment is properly disinfected prior to being shipped.
    - Do not carpool with others unless all individuals are comfortable with traveling together.
    - For company owned vehicles limit sharing of vehicles with coworkers. If unable to limit sharing of company owned vehicles, properly clean vehicle before driving with a focus on commonly touched surfaces (e.g., steering wheels, shifters, buttons, etc.).
    - Use caution when using public restrooms, portable toilets. Use paper towel as a barrier when touching door handles and faucets.
- ***Cleaning and Disinfecting***
    - Clean high touched surfaces daily. Examples of high-touch surfaces include: counters, tables, doorknobs, handles, stair rails, desks, toilets, faucets, and sinks. In most situations, regular cleaning (at least once a day) is enough to sufficiently remove virus that may be on surfaces. However, if certain conditions apply, you may choose to disinfect after cleaning. When there is no confirmed or suspected COVID-19 cases known to have been in a space, cleaning once a day is usually enough to sufficiently remove virus that may be on surfaces and help maintain a healthy facility.
    - You may want to either clean more frequently or choose to disinfect in addition to cleaning in shared spaces if the space:
        - Is a high traffic area, with a large number of people,
        - Is poorly ventilated,
        - Does not provide access to handwashing or hand sanitizer, or
        - The space is occupied by individuals at increased risk for severe illness.

If a someone who tested or is presumed COVID-19 positive and has been in your facility within the last 24 hours, you should clean and disinfect the space. This will be done in consultation with the CHSD.

The following below outlines cleaning and disinfection protocols for specific types of surfaces as required. Please consult with the CHSD when developing site-specific cleaning and disinfection protocols.

- ***Hard (Non-porous) Surfaces***
    - If surfaces are dirty, they should be cleaned with a detergent/soap and water prior to disinfection.
    - Refer to the manufacturer’s instructions to ensure safe and effective use of the product and wear appropriate personal protective equipment (e.g., gloves, safety glasses, face shield).
    - Many products require:
        - Keeping surface wet for a period of time (i.e., contact time).
            - Refer to manufacturer’s instructions outlining adequate contact time.
        - Precautions such as wearing gloves and making sure you have good ventilation during use of the product.
    - Disposable gloves should be removed aseptically and discarded after cleaning. Wash hands immediately following removal of gloves. Refer to Appendix C for how to remove gloves aseptically.

  - If products on EPA List N: Disinfectants for Coronavirus (COVID-19) are not available, bleach solutions can be used if appropriate for the surface and will be effective against coronaviruses when properly diluted.
    - Most household bleach contains 5%–9% sodium hypochlorite. Do not use a bleach product if the percentage is not in this range or is not specified, such as some types of laundry bleach or splash-less bleach as these are not appropriate for disinfection.
    - Follow the directions on the bleach bottle for preparing a diluted bleach solution. If your bottle does not have directions, you can make a bleach solution for disinfecting by mixing:
      - 5 tablespoons (1/3 cup) of bleach per gallon of room temperature water; OR
      - 4 teaspoons of bleach per quart of room temperature water.
    - Follow the manufacturer's application instructions for the surface. If instructions are not available, leave the diluted bleach solution on the surface for at least 1 minute before removing or wiping. This is known as the "contact time" for disinfection. The surface should remain visibly wet during the contact time.
    - Ensure proper ventilation during and after application (for example, open windows).
    - Never mix household bleach (or any disinfectants) with any other cleaners or disinfectants. This can cause vapors that may be very dangerous to breathe in.
    - Make a new diluted bleach solution daily. Bleach solutions will not be as effective after being mixed with water for over 24 hours. Products with EPA-approved emerging viral pathogen claims are expected to be effective against COVID-19. Follow the manufacturer's instructions for all cleaning and disinfecting products (e.g., concentration, application method and contact time, etc.).
- ***Soft (Porous) Surfaces***
  - For soft (porous) surfaces, remove visible contamination if present and clean with appropriate cleaners indicated for use on the surfaces. After cleaning:
    - Launder items as appropriate in accordance with the manufacturer's instructions. If possible, launder using the warmest appropriate water setting for the item and dry items completely; or
    - Use products with the EPA-approved emerging viral pathogens that claim they are suitable for porous surfaces.
- ***Electronics***
  - For electronics such as tablets, touch screens, keyboards, remote controls, etc. remove visible contamination if present.
    - Follow the manufacturer's instructions for all cleaning and disinfection products.
    - Consider use of wipeable covers for electronics.
    - If no manufacturer guidance is available, consider the use of alcohol-based wipes or sprays containing at least 70% alcohol to disinfect touch screens. Dry surfaces thoroughly to avoid pooling of liquids.
- ***Linens, Clothing, and Other Items that Go in the Laundry***
  - Although it is unlikely field clothing would become potentially contaminated with COVID-19, it is recommended that field staff regularly launder field clothing following any field event upon returning home.
  - In order to minimize the possibility of dispersing the virus from potentially contaminated clothing, do not shake dirty laundry.
  - Wash items as appropriate in accordance with the manufacturer's instructions. If possible, launder items using the warmest appropriate water setting for the items and dry items completely.
  - Clean and disinfect hampers or other containers used for transporting laundry according to guidance listed above.

- ***Office/Site Specific-Cleaning and Disinfection Protocols***
  - Each office and long-term field site shall develop internal cleaning and disinfecting practices, which can be broken into three categories: routine cleaning; enhanced cleaning and disinfecting; and deep cleaning and disinfecting.
  - In the instance there is someone who is suspected or confirmed positive for COVID-19 and has worked at the office or field site within the last 24 hours, deep cleaning and disinfecting shall be considered. The CHSD shall work with the OM and Office Health and Safety Manager (OHSM) to evaluate site-specific measures that shall be carried out prior to deep cleaning and disinfecting. If more than 24 hours have passed since the person who is sick or diagnosed with COVID-19 has been in the space, cleaning shall be carried out. You may choose to also disinfect depending on certain conditions and in consultation with the CHSD.
  - If deep cleaning and disinfection is carried out the following will be considered:
    - Closing off all areas potentially affected and wait at least several hours before you clean and disinfect.
    - Areas should remain closed off until cleaning and disinfecting takes place; if able, ventilation shall be increased in the space (e.g., opening doors, windows, increasing CFM).

11. FACE COVERINGS

The CDC recommends the use of face coverings/masks in public settings where other social distancing measures are difficult to maintain. Masks are required on planes, buses, trains and other forms of public transportation traveling into, within, or out of the United States and in U.S. indoor transportation hubs such as airports and stations. The use of face coverings is to supplement and NOT replace the existing practices outlined above.

Based on existing studies and on-going recommendations and/or requirements from federal, state, and local entities, Roux is recommending the use of face coverings, when appropriate. Appropriate use is defined when local authorities or clients require the use of face coverings in conjunction with established social distancing, or if an employee elects to use a cloth covering on their own accord. Roux will provide appropriate face coverings that shall meet the basic requirements outlined by the CDC guidance.

Face Coverings (i.e., masks) should:

- Have two or more layers of washable, breathable fabric;
- Completely cover the nose and mouth;
- Fit snugly against the sides of the face and not have any gaps; and
- Have a nose wire to prevent air from leaking out of the top of the mask.

When donning and doffing the face covering, individuals should avoid touching their eyes, nose, and mouth. Following removal of the face covering, employees should wash their hands immediately using the guidelines described in Section 10 Infection Prevention Measures-Personal Hygiene above. Face coverings should be routinely washed depending on the frequency of use.

APPENDIX A

Roux Subcontractor Work Crew COVID-19 Daily Health Screening Questionnaire

Subcontractor Work Crew
COVID-19 Daily Health Attestation

Date:

Company Name:

Supervisor Name: Signature:

Project Name:

Site Address:

Number of Workers on site:

Prior to entry onto a field site, the following questions shall be asked by the Subcontractor Supervisor to their work crew. **Subcontractors and Field Teams shall self-attest to vaccination status in order to ensure compliance with state/local guidance for fully vaccinated and unvaccinated individuals.**

It is preferred this questionnaire is completed for each individual prior to their arrival at the field site. If the answer to any of these questions is YES, the worker is not to report to the field site and seek proper medical advice, in accordance with CDC Guidelines. **The Subcontractor Supervisor must provide this form on a daily basis to the Roux primary contact for the project and notify Roux of any YES responses.**

1. Have you experienced any signs/symptoms of COVID-19 such as fever (≥100.4°F), cough, shortness of breath, chills, fatigue, muscle/body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea/vomiting or diarrhea in the last 5 days?

2. Have you been in close contact* with someone who is suspected or confirmed to have COVID-19 or who is under investigation for COVID-19 within the last 5 days?

*Close contact as defined by the CDC is being within 6 feet of someone who has COVID-19 for a cumulative total of 15 minutes or more over a 24-hour period. Those who are up to date on COVID-19 vaccinations or had confirmed COVID-19 within the past 90 days (you tested positive using a viral test) you do not need to quarantine.

3. Have you traveled outside of the country, been on a cruise ship and/or traveled to areas within the United States which have state mandated travel restrictions in the last 5 days?

4. Have you tested positive for COVID-19 within the last 5 days?

Please list the crew member’s names on site for the day.

1.	8.
2.	9.
3.	10.
4.	11.
5.	12.
6.	13.
7.	14.

APPENDIX B

Job Safety Analysis-Working in Areas Affected by COVID-19

JOB SAFETY ANALYSIS Ctrl. No. CVD-19	DATE: 01/10/2022	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Fieldwork**	WORK ACTIVITY (Description) **Working in Areas Affected by Coronavirus**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Kristina DeLuca	Health and Safety Specialist	Brian Hobbs	CHSD

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT – In field ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES – In field	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES – Steel/composite toe in fie	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING – High visibility vest in field	☒ GLOVES – Leather/cut-resistant in field and nitrile as needed ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Face covering/mask, nitrile gloves, hand soap, water source, hand sanitizer, disinfectant spray and disinfectant wipes.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

SOCIAL DISTANCING: Maintain 6’ of distance between yourself and all other people at all times. If you do not believe the scope of work can be conducted while maintaining this distance, contact your Project Manager immediately.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Project Preplanning	N/A	• Review and follow COVID-19 CDC, Roux, Client and local orders/protocols. • Ensure all workers are fit for duty - anyone feeling sick should remain at home even if symptoms do not align with COVID-19. If a worker has been in contact with someone potentially positive or positive for COVID-19, contact your Office Manager. • Determine PPE needs and ensure adequate supply of disinfectant wipes/spray, soap and water or hand sanitizer at Site. Due to high demands and limited supply, plan ahead. • Use the minimum number of employees necessary to safely complete the work.
2. Mobilization	**Exposure:** Becoming infected or infecting co-workers	**Personal/Rental/Roux Owned Vehicle** • Avoid carpooling, unless all individuals are up to date on vaccinations. • Verify workers/other people are not approaching vehicle prior to exiting the vehicle. Maintain 6’ of distance from general public, as appropriate. **Public Transportation** • Public transit should not be used unless absolutely necessary. Consider renting a car rather than taking public transit. If public transit is required, wear appropriate face covering/mask and apply social distancing (6 ft). Wash hands or use hand sanitizer immediately after. **Hotel Stay (Refer to COVID-19 H&S Guidance for more info)** • If a hotel stay is deemed necessary for the given field work, ensure that you clean your room upon initial arrival. • Place the “Do Not Disturb” placard on the room while away and limit housekeeping services to the extent feasible during your stay to minimize the reintroduction and spread of the virus from others.. Wash hands or use hand sanitizer often.
3. Tailgate Meeting	**Exposure:** Becoming infected or infecting co-workers	• Perform outside or indoors in areas with ample ventilation. • If unvaccinated, maintain at least a 6+ ft distance between you and others. • Discuss primary infection prevention measures listed below. • Discuss COVID-19 symptoms with coworkers and subcontractors to ensure fitness for duty. Anyone exhibiting signs or symptoms should be instructed to leave the Site, contact your Project Manager.

---

[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object;
Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards, energy source; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

4. Site Activities	**Exposure:** Becoming infected or infecting co-workers	• Coordinate field activities at the beginning of the day (i.e. Tailgate meeting) to minimize time spent in crowded spaces or overlap while completing job tasks. • Don face coverings as appropriate. • Apply social distancing (6+ ft) when interacting with others if unvaccinated. If anyone comes within 6 ft of you while conducting work and your work prevents you from moving away, politely ask them to move back. If others are unable to move from your space, stop work and leave area. • Minimize shaking hands or touching others. • Minimize sharing of equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g. nitrile gloves), as appropriate. • If anyone is experiencing COVID-19 signs or symptoms in your vicinity, stop work and leave the area. • Do not work in areas with limited ventilation with others. • Cover your mouth and nose with tissue or paper towel or with your elbow when coughing or sneezing and wash hands or use hand sanitizer immediately after. If sick contact SHSO/PM and leave Site immediately. • Clean work surfaces/areas with approved cleaners you're responsible for (ex: desk, office doorknob, computer, etc.) at least daily. • Avoid public spaces and going out to eat by bringing your own lunch to the Site. If performing work in high density urban areas, it is recommended all food must be consumed at or in your vehicle or within designated work trailer. Wash hands or use hand sanitizer before eating and immediately after.

Primary Infection Prevention Measures

- Wash your hands often with soap and water for at least 20 seconds.
    - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% alcohol. Key times to wash hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
- Do not touch your eyes, face, nose and mouth with unwashed hands.
- Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw potentially contaminated items (e.g. used tissues) in the trash.
- Avoid close contact/secondary contact with people and potentially contaminated surfaces.
    - Apply appropriate social distance (6+ feet).
    - Minimize handshaking/touching others and use caution when accessing public spaces.
- Clean frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboard, toilets, sinks and field equipment. If surfaces are dirty, they should be cleaned with soap and water prior to disinfection. If surface cannot be cleaned/disinfected, then wash hands or use sanitizer as soon as possible.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

APPENDIX C

How to Remove Gloves

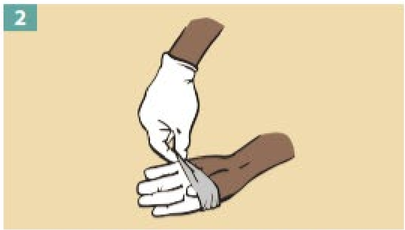
How to Remove Gloves

To protect yourself, use the following steps to take off gloves

1

Grasp the outside of one glove at the wrist.
Do not touch your bare skin.

2

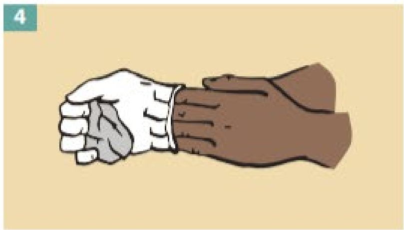


Peel the glove away from your body,
pulling it inside out.

3

Hold the glove you just removed in
your gloved hand.

4



Peel off the second glove by putting your fingers
inside the glove at the top of your wrist.

5

Turn the second glove inside out while pulling
it away from your body, leaving the first glove
inside the second.

6

Dispose of the gloves safely. Do not reuse the gloves.

7

Clean your hands immediately after removing gloves.

APPENDIX E

Heat Illness Prevention Program

HEAT ILLNESS
PREVENTION PROGRAM

CORPORATE HEALTH AND SAFETY DIRECTOR	:	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	:	**10/2019**
REVISION DATE	:	**6/2021**
REVISION NUMBER	:	**1**

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1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has established this heat illness prevention program to assist in preventing workplace accidents, injuries and illnesses associated with temperature extremes. Roux is committed to taking every precaution to protect employees who might be exposed to heat stress, including establishing safe work practices, heat illness prevention controls, and emergency preparedness, which will be detailed in this plan.

2. SCOPE AND APPLICABILITY

Roux’s Heat Illness Prevention Program applies to all employees who may be exposed to heat stress in the field.

3. ROLES AND RESPONSIBILITIES

The Heat Illness Prevention Program Administrator for Roux is the Corporate Health and Safety Director (CHSD), Brian Hobbs, CIH, CSP. The daily administration of the program is delegated to the Office Manager (OM) and Office Health and Safety Manager (OHSM). The CHSD has the authority and responsibility and overall accountability for the comprehensive implementation of this program.

All managers and supervisors shall implement and maintain the heat illness prevention program in work areas where there is a potential for heat stress.

Management Responsibilities

Management (i.e. Project Managers, Project Principals, OM) must provide the following to promote compliance and foster a good safety culture:

- Comply with applicable standards.
- Inform employees of the provisions of the heat illness prevention program and ensure understanding.
- Provide sufficient water, shade, rest areas, and other heat illness controls for employees.
- Assist with establishing work practices to minimize heat stress risks, such as acclimatization, required rest periods, employee monitoring, and strategic scheduling.
- Encourage employees to report hazardous conditions or heat illness symptoms.
- Provide training to any employee who could possibly be exposed to the risk of heat illness.

Employee Responsibilities

Employees are expected to actively participate in the organization’s heat illness prevention program, which includes the following responsibilities:

- Receive appropriate training with regards to heat stress.
- Understand core concepts of heat illness prevention and follow guidelines to mitigate risks.
- Recognize the signs and symptoms of heat illness and immediately report them.
- Cooperate with workplace inspections and incident investigations.

Effective Communication

All Roux employees shall be accountable for ensuring there is effective communication with both the field team and their subcontractors. Communication between Roux employees project leads (e.g. Project Principal, Project Managers) and subcontractors (if applicable) will be established and maintained, so that employees can quickly contact should there be a change in condition or someone at the Site exhibits signs/symptoms of heat stress. These types of incidents would follow Roux's Incident Investigation and Reporting Management Program 2.12 and Roux's Injury Illness Prevention Program 2.22.

4. HAZARD IDENTIFICATION AND ASSESSMENT

Prior to scheduled field work the project team shall ensure a hazard assessment is conducted as it relates to heat stress. This will include a determination of how much heat and exertion employees are likely to be exposed to based on the work activity.

Factors which can increase heat stress can include the following:

- Temperatures at the work site
- Humidity
- A lack of air movement or exchange
- The amount of time employees spend working in the heat
- The time of day work takes place
- Sources of radiant heat (e.g., sunlight, fire, or hot furnace)
- Work activities which produce heat (e.g., welding)
- Physical contact with warm or hot objects or liquids
- The clothing and PPE employees are required to wear
- Physically strenuous work

Results of the hazard analysis should be used to determine appropriate controls for mitigating heat stress whenever possible, for planning acclimatization and for developing work schedules which rotate workers to limit employee exposure. Typically, the Site Supervisor (SS) or Site Health and Safety Officer (SHSO) shall conduct worksite observations to assure all employees follow heat illness prevention procedures and that hazards are sufficiently controlled. However, all employees should be continuously evaluating work site conditions and be able to recognize heat stressors in order to prevent heat illnesses.

5. TRAINING

All Roux employees shall be trained on the topics listed below prior to beginning work which may potentially expose workers to heat stress.

Training Topics

- The environmental, behavioral, and personal risk factors for heat illness, such as radiant heat sources, exertion, clothing and PPE, and use of alcohol or drugs.
- Types of heat illnesses, common symptoms, and appropriate emergency response for each.
- The knowledge that mild symptoms may quickly become more severe or life-threatening.
- The importance of immediately reporting any signs or symptoms of heat illness to the supervisor.
- The employer's responsibility to provide shade, water, access to first aid, and cool-down rests during work and the employee's freedom to exercise their rights under this standard without fear of retaliation.

- The employer's heat stress plan and its procedures:
    - Procedures for employees who are newly assigned to work in high heat areas.
    - The organization's acclimatization methods, as applicable.
    - Heat wave procedures.
    - Heat illness and emergency response, including contact information.
- The importance of frequent consumption of water and the taking of rest breaks.
- How heat illness prevention applies to employees' specific tasks.

Increasing Training Effectiveness:

- The SS/SHSO will hold daily tailgates with the field team to go over daily work tasks and basic safety information including Job Safety Analysis (JSA) review as well as incorporate elements such as current weather and effects on the work activities for the day.
- If a heat wave or high heat is anticipated, OHSMs and/or OMs will provide communications to Roux employees prior to their shifts and remind them of any special high heat procedures.

6. DRINKING WATER

Employees shall be given access to potable drinking water. Access to water will be provided as near as possible to where employees are working, and there shall be enough locations so employees will have sufficient water. Water should be fresh and pure, free of taste or smell that would discourage employees from drinking, comfortably cool and obtained from an approved source.

The recommendation is that during warm or hot weather employees drink four 8-ounce glasses of water, or a total of one quart per hour, throughout the entire work shift. Easy access to sufficient potable drinking water throughout the work shift encourages employees to drink.

During a heat wave, water shall be replenished more often to keep available and cool. Water containers (and all spouts and levers) must be kept clean. If able provide single use drinking cups with appropriate waste receptacle. Accessible sanitation facilities shall also be maintained at work Sites as appropriate.

SS/SHSO are responsible for the following:

- Drink sufficient water before, during and after work shifts to maintain hydration.
- Encourage frequent drinking of small amounts of water throughout the shift. In high heat environments, remind field staff and subcontractors that drinking extra water may be necessary.
- Discourage the choosing of drinks with caffeine or sugar that may possibly dehydrate employees instead of water. Also, discourage the drinking of alcohol.
- Monitor the water supply.
- If employees become dehydrated and are unable to alleviate symptoms with the steps below, get them immediate medical attention.

Field Staff/Subcontractors are responsible for the following:

- Drink sufficient water before, during and after work shifts to maintain hydration. Drink up to 4 cups of water per hour, especially during hot weather.
- Be aware that in high heat situations, you may need to drink more water.

- Monitor yourself and others for signs of dehydration. If you feel dehydrated:
    - Follow Roux's Incident Notification Flowchart
    - Rest in the shaded resting area
    - Drink water in small amounts but frequently

7. ACCESS TO SHADE

Access to shaded areas will be provided to Roux staff as needed. Employees are encouraged to use these areas when they feel overheated. Roux's SS/SHSO shall oversee the proper implementation of shaded areas and will communicate these locations on a daily basis with the Field Team.

Depending on the Site shaded areas can include the following:

- Pop-up Tents
- Canopies
- Umbrellas
- Structures mechanically ventilated or open to air movement
    - Garage
- Conex mounted RV canopies
- Full and thick tree canopies that block direct sunlight
- Buildings
- Enclosed areas only if they provide cooling comparable to shade in open air
    - Vehicles with air conditioning

Shaded Area Requirements

Shade shall be strong enough to cool employees down and other shadows should not be visible in the shade. Shade will be provided by Roux when the air temperature exceeds 80°F. If the temperature is less than 80°F, shade will be available and provided upon request. The SS/SHSO will monitor conditions to determine when the air will exceed (and is exceeding) 80°F. For most Sites air will be monitored hourly and shade will be setup immediately if 80°F is exceeded.

Shade shall be located as close as practical to areas where employees are working, and is easily accessible. These areas will be considered safe and free from other hazards. Shaded areas should be large enough to accommodate all employees who are on a break, resting or recovering without crowding. Should natural vegetation be used for shade the SS/SHSO will evaluate shade for effectiveness.

Field Staff Responsibilities

Field Staff should take ordinary rest breaks in the shaded areas and monitor themselves for signs of heat stress, and go to the shaded area when they need to cool down. Any issues or problems with shaded areas should be reported to the SS/SHSO for the Site.

If shaded areas are used for a preventative cool-down the SS/SHSO will ensure the affected employees will remain in the shade until they begin to feel better. The SS/SHSO will continue to monitor the employees and ask them if they are experiencing symptoms of a heat illness. Employees shall not be sent back to work before symptoms have ended and at a minimum at least 10 minutes of rest.

8. MONITORING AND SCHEDULING

Monitoring

The SS/SHSO and Field Team will continue to monitor themselves and others for signs of heat illness. The SS/SHSO will monitor when the air temperature exceeds 80°F. Throughout the summer, weather and temperature will be monitored at least two weeks ahead, and the work schedule will be planned to accommodate the expected weather.

Scheduling

Scheduling accommodations may include:

- Working during cooler hours of the day
- Working at night
- Stopping work early
- Rescheduling work activities
- Increasing frequency of breaks

In general, strenuous work activities shall be rescheduled to the coolest parts of the day.

Special precautions are required for temperatures above 80°F, 95°F and heat waves. These precautions are provided in sections below.

8. ACCLIMATIZATION AND NEW EMPLOYEE PROCEDURES

Roux requires employees to be acclimatized in order for them to better tolerate heat in the workplace. Acclimatization is the physical process of adapting to a different thermal environment, allowing a better toleration of heat. Acclimatization procedures require gradual exposure that gives the employee time to adjust to each level of exposure. Acclimatization is essential for new employees, but is necessary for all employees when the temperature significantly changes. Heat stress is much more likely if these procedures are not followed.

The SS/SHSO is responsible for observing new employees during their first 14 days of employment in high heat areas.

Re-acclimatization is necessary if employees are absent from high heat environments for a week or more or the temperature increases significantly.

9. HEAT WAVE AND EXTREME HEAT PROCEDURES

Heat Wave Procedures

A heat wave is defined as consistent temperatures over 80°F or if the temperature is 10° higher than the average daily temperatures in the preceding 5 days.

SS/SHSO and Project Management (e.g. PP, PM) shall closely observe and monitor employees during a heat wave. The Field Teams should institute a ratio of one SS to 20 or fewer employees, a mandatory buddy system, or a consistent practice for supervisors to check on employees. Pre-shift meetings to review high heat procedures with employees will be carried out to emphasize work rest schedules, drinking water, shade, etc.

Extreme Heat Procedures

When work site temperatures equal or exceed 95°F, the employer will enact extreme heat procedures:

- Employees will be closely observed by the SS/SHSO for signs of heat illness. New employees will be supervised for acclimatization.
- Effective communication and monitoring will be assured through the use of periodic check ins with the SS/SHSO via phone. Communications between employees and Project Management (e.g. PP/PM) will be established and maintained. Mandatory 10-minute break periods are required for every two hours worked. SS/SHSO must enforce this rule.
- Pre-shift safety tailgate meetings will occur to review procedures and to remind employees to drink water and take cool-down rests if needed. SS/SHSO shall remind employees to rest and drink water. Employees should drink more water than usual.

10. EMERGENCY RESPONSE PROCEDURES

Roux is dedicated to providing prompt appropriate care for all employees who report or show symptoms of heat illness. If an employee shows signs of heat illness, they will be monitored and shall not be left alone or sent home without being offered first aid or emergency medical services. If on-Site personnel require any medical treatment, the following steps will be taken:

1. Notify Roux's Project and Corporate Management Team for any work-related injury and/or illness occurrence, and communicate with the contracted Occupational Health Care Management Provider, AllOne Health (AOH), immediately following the notifications provided above.
2. Based on discussions with the Project Team, Corporate Management and the AOH evaluation, if medical attention beyond onsite First Aid is warranted, transport the injured / ill person (IP) to the Urgent Care Center, or notify the Fire Department or Ambulance Emergency service and request an ambulance or transport the victim to the hospital, and continue communications with Corporate Management Team. An Urgent Care/Hospital Route map with locations and directions are provided within Site Specific Health and Safety Plans.
3. First aid medical support will be provided by onsite personnel trained and certified in First Aid, Cardio Pulmonary Resuscitation (CPR), Automatic External Defibrillation (AED), and Blood-Borne Pathogens (BBP) Awareness, until relieved by emergency medical services (EMS).
4. The SHSO and Project Manager will perform a Loss Investigation (LI) and the Project Team will complete the final Loss Report.

11. HEAT RELATED ILLNESSES

Heat Stress

Heat stress is a significant potential hazard and can be associated with heavy physical activity and/or the use of personal protective equipment (PPE) in hot weather environments. For these reasons, the company will provide potable drinking water and access to shade or other areas of relief (i.e., air-conditioned vehicles, work trailers). Supervisors, prior to supervising personnel in the field, as well as all personnel involved with the field work of a project, are trained in this HASP which includes preventing heat-related illnesses and the below procedures in response to heat-related symptoms and illness. Since much of our work is dependent upon environmental factors beyond our control, we must closely monitor air temperature and humidity and be aware of avoiding radiant heat sources and providing as much air circulation as possible wherever we work. Physical factors that need to be evaluated as part of our Job Safety Analysis (JSA) reviews include the level of physical activity and duration of work and the type (i.e., color, weight breathability) of the clothing we select. In addition, personal factors such as age, weight, fitness, drug/alcohol use and prior history of heat-related illness need to be considered.

Heat cramps are brought on by prolonged exposure to heat. As an individual sweats, water and salts are lost by the body resulting in painful muscle cramps. The signs and symptoms of heat stress are as follows:

- Severe muscle cramps, usually in the legs and abdomen;
- Exhaustion, often to the point of collapse; and
- Dizziness or periods of faintness.

First aid treatment includes, but is not limited to, shade, rest, and fluid replacement. Typically, the individual should recover within one-half hour while being monitored constantly. If the individual has not improved substantially within 30 minutes and the body temperature has not decreased, the individual should be transported to a hospital for medical attention.

Heat Exhaustion

Heat exhaustion may occur in a healthy individual who has been exposed to excessive heat while working or exercising. The circulatory system of the individual fails as blood collects near the skin to rid the body of excess heat through transference. The signs and symptoms of heat exhaustion are as follows:

- Rapid and shallow breathing;
- Weak pulse;
- Cold and clammy skin with heavy perspiration;
- Skin appears pale;
- Fatigue and weakness;
- Dizziness; and
- Elevated body temperature.

First aid treatment includes, but is not limited to, cooling the victim, elevating the feet, and replacing fluids. If the individual is not substantially improved within 30 minutes and the body temperature has not decreased, the individual should be transported to the hospital for medical attention.

Heat Stroke

Heat stroke occurs when an individual is exposed to excessive heat and stops sweating. This condition is classified as a MEDICAL EMERGENCY requiring immediate cooling of the victim and transport to a medical facility. The signs and symptoms of heat stroke are as follows:

- Dry, hot red skin;
- Body temperature approaching or above 105 degrees F;
- Confusion, altered mental state, slurred speech;
- Seizures;
- Large (dilated) pupils; and
- Loss of consciousness – the individual may go into a coma.

First aid treatment requires immediate cooling and transportation to a medical facility. Heat stress is a significant hazard if any type of protective equipment (semi-permeable or impermeable) that prevents evaporative cooling is worn in hot weather environments.

11. OTHER HEAT CONTROLS

Clothing and PPE

Employees should choose clothing that is reflective, light-colored, lightweight, loose-fitting and breathable. Clothing should cover the exposed parts of the body. In direct sun, hard hats with a brim or bill may be helpful. Should specialized cooling garments be applicable please consult with your OM/OHSM/CHSD.

Managing Employee Risk Factors

It is recommended that employees are aware of how their health can affect their risk of heat stress. The following increases ones risk for a heat related illness:

- A poor level of physical fitness
- Obesity
- Chronic or acute illnesses
- Conditions such as diabetes, heart disease or high blood pressure
- Certain medications, such as diuretics
- Age (60+)

Employees should:

- Maintain their health outside of work
- Be aware of the effects of medications
- Drink adequate amounts of water
- Eat light, cool meals during work shifts and save heavy meals until after the shift is over
- Do not skip meals: food helps replace electrolytes when sweating
- Take breaks as needed
- Do not consume alcohol prior to working in a hot environment

APPENDIX F

Personal Protective Equipment (PPE) Management Program

PERSONAL PROTECTIVE EQUIPMENT MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER : **Brian Hobbs, CIH, CSP**

EFFECTIVE DATE : **01/19**

REVISION NUMBER : **4**

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1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has instituted the following program to establish guidelines for the selection of personal protective equipment (PPE) for use by Roux personnel performing field activities in hazardous environments. PPE is not meant to be a substitute for engineering, work practice, and/or administrative controls, but PPE should be used in conjunction with these controls to protect the employees in the work place. Clothing, body coverings, and other accessories designed to prevent worker exposure to workplace hazards are all types of PPE. To ensure adequate PPE employee-owned PPE is evaluated on a case-by-case basis to insure its adequacy, maintenance and sanitation.

2. SCOPE AND APPLICABILITY

These guidelines apply to all PPE selection decisions to be made in implementing the Roux program. The foundations for this program are the numerous Occupational Health and Safety Administration (OSHA) standards related to PPE cited in 29 CFR 1910 Subpart I, 29 CFR 1926 Subpart E, and the hazardous environment work employee protection requirements under the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 and 1926.65. To ensure hazard assessments are documented the levels of protection, types of protection and tasks requiring protection are covered in site-specific Health and Safety Plans (HASPs) and Job Safety Analyses (JSAs).

3. PROCEDURES

Due to the varied nature of site activities and the different potential hazards associated with different sites, several aspects must be considered when selecting PPE. The following text describes PPE selection logic and provides guidelines and requirements for the appropriate selection and use of PPE.

3.1 Introduction

To harm the body, chemicals must first gain entrance. The intact skin and the respiratory tract are usually the first body tissues attacked by chemical contaminants. These tissues provide barriers to some chemicals but in many cases, are damaged themselves or are highly permeable by certain chemical compounds. Personal protective equipment therefore is used to minimize or eliminate chemical compounds coming into contact with these first barrier tissues.

The proper selection of equipment is important in preventing exposures. The PM making the selection will have to take several factors into consideration. The level of protection, type and kind of equipment selected depends on the hazardous conditions and in some cases cost, availability, compatibility with other equipment, and performance. An accurate assessment of all these factors must be made before work can be safely carried out.

3.2 Types of PPE

The type and selection of PPE must meet certain general criteria and requirements as required under OSHA 29 CFR 1910.132 and 1926.95. In addition to these general requirements, specific requirements and specifications exist for some types of PPE that form the basis of the protective clothing scheme. Following is a list of the common types of specific PPE and the specific requirements for the PPE type, where applicable:

1. Hard Hats - Regulated by 29 CFR 1910.135 and 1926.100; and, specified in ANSI Z89.1.

2. Face Shields and Safety Glasses - Regulated by 29 CFR 1910.133 and 1926.102; and, specified in ANSI Z87.1.
3. Respiratory Protection - Regulated by 29 CFR 1910.134 and 1926.103.
4. Hand Protection - Not specifically regulated.
5. Foot Protection - Regulated by 29 CFR 1910.136 and 1926.96; and, specified in ANSI Z41.1.
6. Protective Clothing (e.g., fully encapsulated suits, aprons) - Not specifically regulated.

3.3 Protective Clothing Selection Criteria

3.3.1 Chemicals Present

The most important factor in selecting PPE is the determination of what chemicals the employee may be exposed to. On field investigations, the number of chemicals may range from a few to several hundred. The exact chemicals or group of chemicals present at the site (certain groups tend to require similar protection) can be determined by collecting and analyzing samples of the air, soil, water, or other site media. When data are lacking, research into the materials used or stored at the site can be used to infer chemicals possibly on the site.

Once the known or suspected chemicals have been identified, and taking into consideration the type of work to be performed, the most appropriate clothing shall be selected.

Protective garments are made of several different substances for protection against specific chemicals. There is no universal protective material. All will decompose, be permeated by, or otherwise fail to protect under given circumstances. Fortunately, most manufacturers make guides to the use of their products (i.e., Dupont's Tyvek™ Permeation Guide). These guides are usually for gloves and coveralls and typically provide information regarding chemical degradation rates (failure of the material to maintain structural integrity when in contact with the chemical), and may provide information on the permeation rate (whether or not the material allows the chemical to pass through). When permeation tables are available, they shall be used in conjunction with degradation tables to determine the most appropriate protective material.

During most site work, chemicals are usually in mixed combinations and the protective materials are not in continuous contact with pure chemicals for long periods of time; therefore, the selected material may be adequate for the particular chemical and type of work being performed, yet not the "best" protecting material for all site chemicals and activities. Selection shall depend upon the most hazardous chemicals based on their hazards and concentrations. Sometimes layering, using several different layers of protective materials, affords the best protection.

3.3.2 Concentration of the Chemical(s)

One of the major criteria for selecting protective material is the concentration of the chemical(s) in air, liquid, and/or solid state. Airborne and liquid chemical concentrations should be compared to the OSHA standards and/or American Conference of Governmental Industrial Hygienists (ACGIH) and National Institute for Occupational Safety and Health (NIOSH) guidelines to determine the level of skin or other absorptive surface (e.g., eyes) protection needed. While these standards are not designed specifically for skin exposed directly to the liquid, they may provide skin designations indicative of chemicals known to have significant skin or dermal absorption effects. For example, airborne levels of PCB on-site may be low because it is not very volatile, so the inhalation hazard may be minimal; however, PCB-containing liquid coming in direct contact with the skin may cause overexposure. Thus, PCB has been assigned a skin designation in both the OSHA and ACGIH exposure limit tables.

3.3.3 Physical State

The characteristics of a chemical may range from nontoxic to extremely toxic depending on its physical state. Inorganic lead in soil would not be considered toxic to site personnel, unless it became airborne, since it is generally not absorbed through the intact skin. Organic lead in a liquid could be readily absorbed. Soil is frequently contaminated with hazardous materials. Concentrations will vary from a few parts per million to nearly one hundred percent. The degree of hazard is dependent on the type of soil and concentration of the chemical. Generally speaking, "dry" soils do not cause a hazard to site personnel if they take minimal precautions such as wearing some type of lightweight gloves.

3.3.4 Length of Exposure

The length of time a material is exposed to a chemical increases the probability of breakthrough. Determinations of actual breakthrough times for short-term exposures indicate that several different materials can be used which would be considered inadequate under long-term exposures. It should be kept in mind that during testing, a pure (100% composition) liquid is usually placed in direct contact with the material producing a worst-case situation.

3.3.5 Abrasion

When selecting protective clothing, the job the employee is engaged in must be taken into consideration. Persons moving drums or performing other manual tasks may require added protection for their hands, lower chest and thighs. The use of leather gloves and a heavy apron over the other normal protective clothing will help prevent damage to the normal PPE and thus reduce worker exposures.

3.3.6 Dexterity

Although protection from skin and inhalation hazards is the primary concern when selecting PPE, the ability to perform the assigned task must be maintained. For example, personnel cannot be expected to perform work that requires fine dexterity if they must wear a thick glove. Therefore, the PPE selection process must consider the task being performed and provide PPE alternatives or techniques that allow dexterity to be maintained while still protecting the worker (e.g., wearing tight latex gloves over more bulky hand protection to increase dexterity).

3.3.7 Ability to Decontaminate

If disposable clothing cannot be used, the ability to decontaminate the materials selected must be taken into consideration. Once a chemical contacts the material, it must be cleaned before it can be reused. If the chemical has completely permeated the material, it is unlikely that the clothing can be adequately decontaminated and the material should be discarded.

3.3.8 Climactic Conditions

The human body works best with few restraints from clothing. Protective clothing adds a burden by adding weight and restricting movement as well as preventing the natural cooling process. In severe situations, a modified work program must be used.

Some materials act differently when they are very hot and very cold. For example, PVC becomes almost brittle in very cold temperatures. If there are any questions about the stability of the protective materials under different conditions, the manufacturer should be contacted.

3.3.9 Work Load

Like climactic conditions, the type of work activity may affect work duration and the ability or personnel to perform certain tasks. Similarly, the amount of protective materials a person wears will affect their ability to perform certain tasks. For example, a person in a total encapsulating suit, even at 72 ^{o}F, cannot work for more than a short period of time without requiring a break.

The work schedule should be adjusted to maintain the health of the employees. Special consideration should be given to the selection of clothing that both protects and adds the least burden when personnel are required to perform strenuous tasks. Excessive bodily stress frequently represents the most significant hazard encountered during field work.

3.4 Types of Protective Materials

1. Cellulose or Paper
2. Natural and Synthetic Fibers
   a. Tyvek™
   b. Nomex™
3. Elastomers
   a. Polyethylene
   b. Saran
   c. Polyvinyl Chloride (PVC)
   d. Neoprene
   e. Butyl Rubber
   f. Viton

3.5 Protection Levels

3.5.1 Level A Protection

Level A protection (a fully encapsulated suit) is used when skin hazards exist or when there is no known data that positively rule out skin and other absorption hazards. Since Level A protection is extremely physiologically and psychologically stressful, the decision to use this protection must be carefully considered. At no time will Level A work be performed without the consent of the OM. The following conditions suggest a need for Level A protection:

- confined facilities where probability of skin contact is high;
- sites containing known skin hazards;
- sites with no established history to rule out skin and other absorption hazards;
- atmosphere immediately dangerous to life and health (IDLH) through the skin absorption route;
- site exhibiting signs of acute mammalian toxicity (e.g., dead animals, illnesses associated with past entry into site by humans);

- sites at which sealed drums of unknown materials must be opened;
- total atmospheric readings on the Photoionization Detector (PID), Flame Ionization Detector (FID), and similar instruments indicate 500 to 1,000 ppm of unidentified substances; and
- extremely hazardous substances (e.g., cyanide compounds, concentrated pesticides, Department of Transportation Poison "A" materials, suspected carcinogens and infectious substances) are known or suspected to be present and skin contact is possible.

The following items constitute Level A protection:

- open circuit, pressure-demand self-contained breathing apparatus (SCBA);
- totally encapsulated suit;
- gloves, inner (surgical type);
- gloves, outer;
- chemical protective;
- boots, chemical protective, steel toe and shank;
- radiation detector (if applicable); and
- communications.

3.5.2 Level B Protection

Level B protection is utilized when the highest level of respiratory protection is needed but hazardous material exposure to the few unprotected areas of the body is unlikely.

The following conditions suggest a need for Level B protection:

- the type and atmospheric concentration of toxic substances have been identified and they require the highest level of respiratory protection;
- IDLH atmospheres where the substance or concentration in the air does not present a severe skin hazard;
- the type and concentrations of toxic substances do not meet the selection criteria permitting the use of air purifying respirators; and
- it is highly unlikely that the work being done will generate high concentrations of vapors, gases or particulates, or splashes of materials that will affect the skin of personnel.

Personal protective equipment for Level B includes:

- open circuit, pressure-demand SCBA;
- chemical protective clothing:
- overalls and long-sleeve jacket; or
- coveralls;
- gloves, inner (surgical type); gloves, outer, chemical protective;
- boots, chemical protective, steel toe and shank; and
- communications optional.

3.5.3 Level C Protection

Level C protection is utilized when both skin and respiratory hazards are well defined and the criteria for the use of negative pressure respirators have been fulfilled (i.e., known contaminants and contaminant concentrations, acceptable oxygen levels, approved filter/cartridge available, known cartridge service life, etc.). Level C protection may require carrying an emergency escape respirator during certain initial entry and site reconnaissance situations, or when applicable thereafter.

Personal protective equipment for Level C typically includes:

- full facepiece air-purifying respirator;
- emergency escape respirator (optional);
- chemical protective clothing:
  - overalls and long-sleeved jacket; or
  - coveralls;
- gloves, inner (surgical type);
- gloves, outer, chemical protective; and
- boots, chemical protective, steel toe and shank.

3.5.4 Level D Protection

Level D is the basic work uniform. Personal protective equipment for Level D includes:

- coveralls;
- safety boots/shoes;
- eye protection;
- hand protection;
- reflective traffic safety vest (mandatory for traffic areas or railyard);
- hard hat (with face shield is optional); and
- emergency escape respirator is optional.

3.5.5 Level E Protection

Level E protection is used when radioactivity above 10 mr/hr is detected at the site. Personal protective equipment for Level E includes:

- coveralls;
- air purifying respirator;
- time limits on exposure;
- appropriate dermal protection for the type of radiation present; and
- radiation dosage monitoring.

3.5.6 Additional Considerations

Field work will contain a variety of situations due to chemicals in various concentrations and combinations. These situations may be partially ameliorated by following the work practices listed below:

1. Some sort of foot protection is needed on a site. If the ground to be worked on is contaminated with liquid and it is necessary to walk in the chemicals, some sort of protective "booties" can be worn over the boots. This cuts down on decontamination requirements. They are designed with soles to help prevent them from slipping around. If non-liquids are to be encountered, a Tyvek™ bootie could be used. If the ground contains any sharp objects, the advantage of booties is questionable. Boots should be worn with either cotton or wool socks to help absorb the perspiration.
2. If the site situation requires the use of hard hats, chin straps should be used if a person will be stooping over where his/her hat may fall off. Respirator straps should not be placed over the hard hats. This will affect the fit of the respirator.

   Some types of protective materials conduct heat and cold readily. In cold conditions, natural material clothing should be worn under the protective clothing. Protective clothing should be removed prior to allowing a person "to get warm". Applying heat, such as a space heater, to the outside of the protective clothing may drive the contaminants through. In hot weather, under clothing will absorb sweat. It is recommended that workers use all cotton undergarments.
3. Body protection should be worn and taped to prevent anything from running into the top of the boot. Gloves should be worn and taped to prevent substances from entering the top of the glove. Duct tape is preferred, but masking tape can be used. When aprons are used, they should be taped across the back for added protection. However, this should be done in such a way that the person has mobility.
4. Atmospheric conditions such as precipitation, temperature, wind direction, wind velocity, and pressure determine the behavior of contaminants in air or the potential for volatile material getting into the air. These parameters should be considered in determining the need for and the level of protection.
5. A program must be established for periodic monitoring of the air during site operations. Without an air monitoring program, any changes would go undetected and might jeopardize response personnel. Monitoring can be done with various types of air pumps and filtering devices followed by analysis of the filtration media; personnel dosimeters; and periodic walk-throughs by personnel carrying real-time survey instruments.
6. For operations in the exclusion zone, different levels of protection may be selected, and various types of chemical-resistant clothing may be worn. This selection should be based on the job function, reason for being in the area, and the potential for skin contact with, or inhalation of, the chemicals present.
7. Escape masks must be readily available when levels of respiratory protection do not include a SCBA and the possibility of an IDLH atmosphere exists. Their use can be made on a case-by-case basis. Escape masks could be strategically located at the site in areas that have higher possibilities of vapors, gases or particulates.

APPENDIX G

Heavy Equipment Exclusion Zone Policy

HEAVY EQUIPMENT EXCLUSION ZONE MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	**:**	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	**:**	**01/2019**
REVISION NUMBER	**:**	**1**

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1. PURPOSE

The purpose of the Exclusion Zone Management Program is to establish the minimum clearance distance that must be maintained between workers and heavy equipment while equipment is in operation (i.e., engaged or moving). The intent is to have no personnel or equipment entering the Exclusion Zone while the equipment is in operation or moving to ensure that Roux and Subcontractor employees are not unnecessarily exposed to the hazards of the equipment.

2. SCOPE AND APPLICABILITY

This Management Program applies to all Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) employees and their subcontractors who are performing field work and are potentially exposed to heavy equipment. For the purpose of this program, heavy equipment includes, but is not necessarily limited to: excavation equipment, drill rigs, vacuum trucks, forklifts, lull telehandlers, man lifts, bobcats, delivery trucks, etc.

3. PROCEDURES

As specified in the following sections of this Program, an Exclusion Zones must be established and maintained during activities involving the movement/operation of heavy equipment. The Exclusion Zone requirements apply to all personnel on the site but are primarily focused on those personnel who are required to be working in the vicinity of the equipment. The exclusion zone is in effect when heavy equipment is moving or engaged (ex. movement of an arm or bucket of an excavator, rotation of an auger, lifting of a load with a forklift, raising/lowering of a man lift, etc.).

1. The Exclusion Zone must meet the following minimum requirements:
    - A minimum distance of 10 feet from all heavy equipment and loads being moved by the equipment;
    - Greater than the swing/reach radius of any moving part on the heavy equipment (i.e., for large equipment this may mean an exclusion zone distance larger than 20 feet);
    - Greater than the tip-over distance of the heavy equipment; and
    - Greater than the radius of blind spots.

    > The size of the Exclusion Zone will need to be determined on a task-specific basis considering the size of the heavy equipment in use and the task being performed. Prior to all heavy equipment operations, the Exclusion Zone(s) distance must be specifically identified in the Job Safety Analysis (JSA).

2. The spotter (or another individual) should be assigned responsibility for enforcing the Exclusion Zone. The spotter should be positioned immediately outside of the Exclusion Zone within a clear line of sight of the equipment operator. The spotter must signal the operator to stop work if anyone or anything has the potential to enter or compromise the Exclusion Zone. The operator should stop work if the spotter is not within his/her line of sight. If multiple pieces of equipment are being used, each piece of equipment must have its own Exclusion Zone and spotter. For large excavation and demolition projects the spotter should be in constant radio contact (not cell phone) with the machine driver.
3. If an individual must enter the Exclusion Zone, the designated Spotter must signal the Equipment Operator to stop the equipment. Once the equipment is no longer moving (ex. movement of an arm of an excavator is STOPPED, lifting of a load with a forklift STOPPED, raising/lowering of a man lift is

STOPPED, etc.), the operator must DISENGAGE THE CONTROLS and STOP and SIGNAL BY "SHOWING HIS HANDS". This signal will indicate that it is safe for the personnel to enter the limits of the Exclusion Zone to perform the required activity. The equipment must remain completely stopped/disengaged until all personnel have exited the limits of the Exclusion Zone and the designated Spotter has signaled by "SHOWING HIS HANDS" to the Equipment Operator that it is safe to resume operations.

4. When entering the limits of the Exclusion Zone, personnel must at a minimum:
    - Establish eye contact with the operator and approach the heavy equipment in a manner that is in direct line of sight to the Equipment Operator;
    - Never walk under any suspended loads or raised booms/arms of the heavy equipment; and
    - Identify a travel path that is free of Slip/Trip/Fall hazards.
5. The Exclusion Zone should be delineated using cones with orange snow fence or solid poles between the cones, barrels, tape or other measures. For work in rights-of-way rigid barriers, such as Jersey barriers or temporary chain link fence should be used. For certain types of wide-spread or moving/mobile equipment operations, such delineation may not be practicable around pieces of equipment or individual work areas. In such instances, it is expected that the entire operation will be within a larger secure work area or that additional means will be utilized to ensure security of the work zone.

All subcontractors who provide heavy equipment operations to field projects must implement a program that meets or exceeds the expectations described above as well as any additional requirements that may be required on a client or site-specific basis.

3.1 Exceptions

It is recognized that certain heavy equipment activities may require personnel to work within the limits of the Exclusion Zone as specified in this program. Such activities may include certain excavation clearance tasks, drill crew activities or construction tasks. However, any such activity must be pre-planned with emphasis on limiting the amount and potential exposure of any activity required within the zone. The critical safety steps to mitigate the hazards associated with working within the Exclusion Zone must be defined in the JSA and potentially other project-specific plans (i.e., critical lift plans, etc.), and approved by the Roux Project Principal and client representative, if required, prior to implementation.

4. TRAINING

Many Roux projects have different requirements that are client-specific or site-specific in nature. It is the responsibility of the Project Principal (or Project Manager if delegated this responsibility by the Project Principal) to ensure that the workers assigned to his/her projects are provided orientation and training with respect to these client and/or site-specific requirements.

APPENDIX H

Subsurface Utility Clearance Management Program

SUBSURFACE UTILITY CLEARANCE MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	**:**	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	**:**	**01/19**
REVISION NUMBER	**:**	**2**

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APPENDICES

1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, "Roux") has instituted the following program for completing proper utility mark-outs and for conducting subsurface clearance activities. This establishes a method to ensure, to the greatest extent possible, that utilities have been identified and contact and/or damage to underground utilities and other subsurface structures will be avoided.

2. SCOPE AND APPLICABILITY

The Subsurface Utility Clearance Management Program applies to all Roux employees, its contractors and subcontractors. Employees are expected to follow this program for all intrusive work involving Roux or other personnel (e.g., contractors/subcontractors) working for Roux unless the client's requirements are more stringent. Deviation from the program regardless of the specific work activity or work location must be pre-approved based on client's site knowledge, site experience and client's willingness for the use of this program. Any and all exceptions shall be documented and pre-approved by the Project Principal and the Office Manager.

3. PROCEDURES

3.1 Before Intrusive Activities

During the project kick-off meeting for intrusive activities the PM will review the Roux Subsurface Utility Clearance Checklist and Utility Verification (Appendix C) / Site Walkthrough Record (Appendix D) and the below bullet points with the project field team:

(Please note that these are intended as general reminders only and should not be solely relied upon.)

- Ensure the Mark-out / Stake-out Request Information Sheet (or one-call report) is complete and accurate for the site including address and cross streets and review for missing utilities. (Note: utility mark-out organizations do not have contracts with all utilities and it is often necessary to contact certain utilities separately such as the local water and sewer authorities).
- Have written confirmation prior to mobilizing to the site that the firm or Roux personnel performing the intrusive activity has correctly completed the mark-out notification process including requesting mark-outs, waiting for mark-outs to be applied to ground surfaces at the site, and receiving written confirmation of findings (via fax or email) from utility operators for all known or suspected utilities in the proposed area of intrusive activity, and provided utility owner written confirmation to Roux personnel for review and project files documentation.
- Do not begin any intrusive activity until all utilities mark-out has been completed (i.e., did all utilities mark-out the site?) and any unresolved mark-out issues are finalized. Perform a site walk to review the existing utilities and determine if said utilities have been located by the utility locators.

  (Note: The Tolerance Zone is defined as two feet plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct banks and other non-cylindrical utilities) of a utility and two feet from the outside edge of any subsurface structure.)
- Install Pre-Clearance exploratory test holes (e.g., hand-dug test holes or other soft digging techniques) for the first 5-ft below land surface (BLS) at each location prior to conducting mechanized intrusive activities. The size of the pre-clearance exploratory test hole should be at a minimum twice the diameter of any downhole tool or boring device. (Note: Pre-Clearance exploratory test holes should be defined in the SOW/proposal provided to the client to prevent project delays and to allow adequate time for PM and PP to evaluate alternative approaches for the project. Alternative approaches will need to be pre-approved by the OM.

- For excavations, all utilities need to be marked and then exposed by hand following the protocols in this program. Pre-clearing for excavations may be performed by the “moat” technique (i.e., soft digging around the perimeter). In these cases, dig in small lifts (<12” for first 5 feet) using a dedicated spotter.) For Tolerance Zone work, unless otherwise agreed upon with the Utility Operator, work within the tolerance zone requires verification by means of hand-dug test holes performed to expose the utility. Once structures have been verified a minimum clearance of two feet must be maintained between the utility and any powered equipment.
- In addition, the following activities should be conducted:
    - Review the work scope to be performed with the site owner/tenant to determine if it may impact any utilities;
    - Attempt to procure any utility maps or historic drawings of subsurface conditions of the site;
    - **Determine the need for utility owner companies to be contacted or to have their representatives on site**;
    - Where mark-outs terminate at the property boundary, consider the use of private utility locating / GPR / geophysical-type services which may be helpful in locating utilities. Use of private utility locating firms, however, does not eliminate the legal requirement for the Excavator firm to submit a request for Public Utility Mark-outs. Also, the information provided by the service may be inaccurate and unable to locate subsurface utilities and structures in urban areas, landfills, urban fill areas and below reinforced slabs, etc. They should not be relied upon as the only means of performing utility clearance;
    - Documented description of the dig site which is included in the projects Health and Safety Plan (HASP) and one call report will be maintained in the field and distributed amongst Roux personnel its contractors and subcontractors; and
    - Documentation of the actual placement of mark outs in the field shall be collected using dated pictures, videos and/or sketches with distance from markings to fixed objects. All documentation shall be maintained within the project file.

3.2 During Intrusive Activities

The PM, field team lead or personnel performing oversight is to:

- Ensure the mark-out remains valid. (In certain states there are limits regarding the duration of time after the mark-out was applied to the ground surface work can be started or interrupted.) Additionally, the mark-outs must be maintained, documented, and in many cases refreshed periodically to be considered valid, this will be accomplished through calls to the one call center.
- Ensure intrusive activities are only performed within the safe boundaries of the mark-out as detailed in the One-Call Report.
- Halt all work if intrusive activities have resulted in discovery of an unmarked utility. Roux personnel shall notify the facility owner/operator and the one call center. All incidents such as this will be reported as per Roux Incident Investigation and Reporting Management Program.
- Halt all work if intrusive activities must take place outside of the safe boundaries of a mark-out and only proceed after new mark-outs are performed.
- Halt the intrusive activities and immediately consult with the PP if an unmarked utility is encountered.
- Completing any subsurface utility clearance incident reports that are necessary.

- If a utility cannot be found as marked Roux personnel shall notify the facility owner/operator directly or through the one call center. Following notification, the excavation may continue, unless otherwise specified in state law.
- Contractors/subcontractors must contact the one-call center to refresh the ticket when the excavation continues past the life of the ticket. Ticket life shall be dictated by state law however at a maximum ticket life shall not exceed 20 working days.

3.3 Stop Work Authority

Each Roux employee has Stop Work Authority which he or she will execute upon determination of any imminent safety hazard, emergency situation, or other potentially dangerous situation, such as hazardous weather conditions. This Stop Work Authority includes subsurface clearance issues such as the adequacy of a mark-out or identification during intrusive operations of an unexpected underground utility. Authorization to proceed with work will be issued by the PM/PP after such action is reviewed and resolved. The PM will initiate and execute all management notifications and contact with emergency facilities and personnel when this action is appropriate.

Appendix A - Definitions

Intrusive Work Activities	All activities such as digging or scraping the surface, including but not limited to, excavation, test pitting or trenching, soil vapor sampling or the installation of soil borings, soil vapor monitoring points and wells, or monitoring wells, and drilling within the basement slab of a recently demolished building.
Mark-out / Stake Out	The process of contracting with a competent and qualified company to confirm the presence or absence of underground utilities and structures. This process will clearly mark-out and delineate utilities that are identified so that intrusive work activities can be performed without causing disturbance or damage to the subsurface utilities and structures. After utility mark-outs are completed the soft digging will be completed prior to intrusive work.
Tolerance Zone	Defined as two feet on either side of the designated centerline of an identified utility, plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct backs and other non-cylindrical utilities) of that utility and two feet from the outside edge of any subsurface structure.
Structure	For the purpose of this program a structure is defined as any underground feature that may a present potential source(s) of energy such as, but not limited to, utility vaults, bunkers, piping, electrical boxes, wires, conduits, culverts, utility lines, underground tanks and ducts.
Soft Digging	The safest way to remove material from unknown obstructions or services is by using tools such as a vactor or air knife, non-mechanical tools, or hand tools. The methods are clean and non-evasive and used for uncovering and exposing buried services, excavating and for providing a quick method of soil removal from sensitive areas.
Verification	Exploratory test-hole dug with hand tools within the Tolerance Zone to expose and verify the location, type, size, direction-of-run and depth of a utility or subsurface structure. Vacuum excavation (soft dig) methods can further facilitate exposure of a subsurface utility and accurately provide its location and identification prior to intrusive work approaching the Tolerance Zone.

Appendix B - Example of Completed One Call Report

Example Completed One-Call Report

New York 811

Send To: C_EMAIL Seq No: 744

Ticket No: 133451007 ROUTINE

Start Date: 12/16/13 Time: 7:00 AM Lead Time: 20

State: NY County: QUEENS Place: QUEENS
Dig Street: 46TH AVE Address:
Nearest Intersecting Street: VERNON BLVD
Second Intersecting Street: 11TH ST

Type of Work: SOIL BORINGS
Type of Equipment: GEOPROBE
Work Being Done For: ROUX

In Street: X On Sidewalk: X Private Property: Other:
On Property Location if Private: Front: Rear: Side:

Location of Work: MARK THE ENTIRE NORTH SIDE OF THE STREET AND SIDEWALK OF: 46TH AVE BETWEEN VERNON BLVD AND 11TH STREET

Remarks:

Nad: Lat: Lon: Zone:
ExCoord NW Lat: 40.7475399 Lon: -73.9534811 SE Lat: 40.7457406 Lon: -73.9493680

Company : ZEBRA ENVIROMENTAL Best Time: 6AM-5PM
Contact Name: DAVID VINES Phone: (516)596-6300
Field Contact: DAVID VINES Phone: (516)596-6300
Caller Address: 30 N PROSPECT AVE Fax Phone: (516)596-4422
LYNBROOK, NY 11563
Email Address: david@zebraenv.com

Additional Operators Notified:

ATTNY01	AT&T CORPORATION	(903)753-3145
CEQ	CONSOLIDATED EDISON CO. OF N.Y	(800)778-9140
MCINY01	MCI	(800)289-3427
PANYNJ01	PORT AUTHORITY OF NY & NJ	(201)595-4841
VZQ	VERIZON COMMUNICATIONS	(516)297-1602

Link to Map for C_EMAIL: http://ny.itic.occinc.com/XGMZ-DF2-L23-YAY

Original Call Date: 12/11/13 Time: 1:15 PM Op: webusr
IMPORTANT NOTE: YOU MUST CONTACT ANY OTHER UTILITIES DIRECTLY

Appendix C - Roux Subsurface Utility Clearance Checklist

Roux Subsurface Utility Clearance Checklist ***Date of Revision – 12/3/14***

Work site set-up and work execution

ACTIVITY	Yes	No	N/A	COMMENTS INCLUDING JUSTIFICATION IF RESPONSE IS NO OR NOT APPLICABLE
Daily site safety meeting conducted, SPSAs performed, JSAs reviewed, appropriate work permits obtained.				
HASP is available and reviewed by site workers / visitors.				
Subsurface Utility Clearance Procedure has been reviewed with all site workers.				
Work area secured; traffic control established as needed. Emergency shut-off switch located. Fire extinguishers / other safety equipment available as needed.				
Utility mark-outs (public / private) clear and visible. Provide Excavator's Stake-Out Reference Number / Request Date / Time.				
Tolerance zone work identified.				
Work execution plan reviewed and adhered to (ground disturbance methods, clearance depths, any special utility protection requirements, or any other execution requirements; especially for Tolerance Zone work).				
Verbal endorsement received from Roux PM for any required field deviations to work execution plan.				

Key reminders for execution:

The Subsurface Utility Clearance Protocol should be referenced to determine all requirements while executing subsurface work. The bullet points below are intended as general reminders only and should not be solely relied upon.

- Tolerance zone is defined as two feet plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct banks and other non-cylindrical utilities) of a utility and two feet from the outside of any subsurface structure.
- Install Pre-Clearance exploratory test holes (e.g., hand-dug test holes or vacuum excavation) must be performed for the first five feet below land surface (BLS) at each location prior to conducting mechanized intrusive activities. The size of the pre-clearance exploratory test hole should be at a minimum twice the diameter of any downhole tool or boring device. (Note: Pre-clearance exploratory test holes should be defined in the SOW/proposal provided to the client to prevent project delays and to allow adequate time for PM and PP to evaluate alternative approaches for the project. Alternate approaches will need to be pre-approved by the OM.
- For excavations, all utilities need to be marked and then exposed by hand following the protocols in this program. Pre-clearing for excavations may be performed by the "moat" technique (i.e., soft

digging around the perimeter). In these cases, dig in small lifts (<12” for first five feet) using a dedicated spotter.) For Tolerance Zone work, unless otherwise agreed upon with the Utility Operator, work within the tolerance zone requires verification by means of hand-dug test holes to expose the utility. Once structures have been verified a minimum clearance of two feet must be maintained between the utility and any powered equipment.

Appendix D - Utility Verification/Site Walkthrough Record

Employee Name:____

Date: ____

Instructions: For each utility suspected at the job site, indicate location on the job site, approximate burial depth, and means of detecting the utility. Leave blank if that utility is not believed to be present.

Utility	Description of Utility Location Identified Onsite	Approx. Depth (bls)	Method / Instrumentation used to determine Utility Location	Utility Owner Response (Date/Time)	Mark Out Indicates (Clear / Conflict)
Electrical Lines					
Gas Lines					
Pipelines					
Steam Lines					
Water Lines					
Sanitary and Stormwater Sewer lines					
Pressured Air-Lines					
Tank Vent Lines					
Fiber Optic Lines					
Underground Storage Tanks					
Phone Lines/ Other					

* bls - below land surface

Site Sketch Showing Utilities:

Color Code

- ELECTRIC
- Gas-oil Steam
- Communications CATV
- WATER
- Reclaimed Water
- SEWER
- Temp. Survey Markings
- Proposed Excavation

Other Comments / Findings:

Completed by: ______________________________

Signature: ______________________________ Date: ______________

APPENDIX I

Incident Investigation and Reporting Management Program

INCIDENT INVESTIGATION AND REPORTING MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	**:**	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	**:**	**01/19**
REVISION NUMBER	**:**	**4**

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Appendix C – Injury Illness Reporting Flow Chart

1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has instituted the following management program for reporting Environmental Health and Safety (EHS) incidents and near losses, investigation and correcting the causes of incidents, tracking incidents and corrective actions taken, and sharing the cause and corrective actions with Roux personnel. These practices and procedures establish a method to track progress and improvements to the company EHS performance.

2. SCOPE AND APPLICABILITY

These procedures apply to all Roux employees. Employees are required to follow these procedures for all incidents involving Roux personnel, or other personnel (e.g., subcontractors) working for Roux, regardless of the specific work activity or work location.

This program is intended, in part, to fulfill the Occupational Safety and Health Administration (OSHA) occupational injury and illness reporting and recording requirements cited in the Code of Federal Regulations (CFR) at 29 CFR 1904.

3. RESPONSIBILITIES

It shall be the responsibility of all Roux employees to report all incidents as soon as possible to the PM (or Administrative Manager for office-related incidents), SHSO, OHSM and OM, regardless of severity. Additionally, the following positions have specific responsibilities for implementing this specific SOP.

3.1 Corporate Health and Safety Manager (CHSM)

- The CHSM has the responsibility of ensuring that a system is in place for reporting, investigation, correction, and communicating of EHS incidents and near losses.
- The CHSM has the overall responsibility of implementing and communicating the contents of this program to Office Health and Safety Managers (OHSMs).
- The CHSM will review all incidents and corrective actions taken. The CHSM will provide a summary of serious incidents to the Board of Directors.
- The CHSM will communicate learnings from incidents and corrective actions taken to all personnel, through quarterly communications.
- The CHSM will periodically review and evaluate the effectiveness of this procedure.

3.2 Office Manager (OM)

- The OM will designate the individual to serve as the OHSM responsibility for ensuring that requirements in this procedure are met.
- The OM will ensure that sufficient resources are allocated to fulfill the requirements of this procedure.
- The OM will conduct final review of all incident reports prepared under this procedure.

3.3 Office Health and Safety Manager (OHSM)

- It is the responsibility of the OHSM to review draft incident reports and assist the OM in finalizing reports of all accidents, illnesses and incidents related to work activity, and to assist the SHSO when necessary.

- The OHSM may not approve a site-specific HASP unless the HASP includes incident reporting procedures and forms.
- The OHSM will suggest and implement corrective actions to prevent the same type of incident from re-occurring.
- The OHSM will keep all incident reports, corrective action taken, and follow-up forms on file. The OHSM will provide copies of all final reports and forms to the CHSM within one week of the incident. If a serious incident occurs, the CHSM will be notified as soon as possible.
- The occurrence of a serious incident will trigger an EHS audit by the OHSM.

3.4 Project Manager (PM)

- It shall be the PM's responsibility to promptly correct any deficiencies that were determined to cause or contribute to the incident investigated.
- If a site-specific HASP is not utilized, the PM must ensure that field personnel have copies of the Roux Accident Reporting and Investigation Forms.
- The PM has the responsibility of ensuring that the SHSO and other field personnel understand the need for timely incident reporting.
- In the event of an incident, the PM will determine the root cause of the incident with the assistance of the SHSO and/or OHSM. The PM should provide input as to corrective preventative measures.

3.5 Site Health and Safety Officer (SHSO)

- The SHSO shall provide the details of the incident to the OHSM, PM and OM. The OM or his delegate will provide additional notifications, such as, in the event of a work-related motor vehicle accident, to include Roux Legal.
- It is the SHSO's responsibility to immediately notify the OHSM and the PM when any incident occurs. Such notification should take place immediately following the completion of any emergency actions required by the HASP.
- The SHSO should provide input as to corrective preventative measures.
- The SHSO must ensure that corrective actions proposed by the OHSM or OM are carried out.

3.6 All Personnel

- All personnel are responsible for reporting and describing the details of any incident in which they are involved to the SHSO and PM. Such notification should take place <u>immediately</u> following the completion of any emergency actions required by the HASP and after the loss and before the scene is disturbed or vehicles moved.

4. PROCEDURE

4.1 Incident Investigation

On receiving a report of incident or near loss occurrence from a Roux employee, the SHSO or OHSM shall immediately investigate the circumstances and shall make appropriate recommendations to prevent recurrence. The Incident Report form can be found in **Appendix A**, and Near Loss form can be found in **Appendix B**. The OHSM may participate in the investigation of more serious accidents and incidents that occur on-site. The Corporate Health and Safety Manager (CHSM) shall also be immediately notified by telephone on occurrence of a serious accident or incident. At the CHSM's discretion, he may also participate in the investigation.

4.2 Incident Report

Details of the incident shall be documented using the Accident Report and Investigation Forms (Appendix A) within twenty-four (24) hours of the incident and shall be distributed to the SHSO, the OHSM, PM, OM and the CHSM. The CHSM will update OSHA Forms 301 and the 300 log when necessary.

Appendix A – Accident Report and Investigation Form

☐ **Roux Environmental Engineering and Geology, D.P.C.**
☐ **Roux Associates, Inc.** ☐ **Remedial Engineering, P.C.**

ACCIDENT REPORT

Brian Hobbs, Corporate Health and Safety Manager
Cell: (631) 807-0193; Office: (631) 630-2416

PART 1: ADMINISTRATIVE INFORMATION

Project #: ______________________________
Project Name: ______________________________
Project Location (street address/city/state):
____
____

Client Corporate Name / Contact / Address / Phone #:
____
____
____
____
____

Immediate Verbal Notifications Given To:

Corporate Health & Safety	☐Yes	☐No
Office Health & Safety	☐Yes	☐No
Office Manager	☐Yes	☐No
Project Principal	☐Yes	☐No
Project Manager	☐Yes	☐No
Client Contact	☐Yes	☐No

REPORT STATUS (time due):

☐ Initial (24 hr) ☐ Final (5-10 days)
Date: ____________ Date: ____________

Accident Report Delivered To:

Corporate Health & Safety	☐Yes	☐No
Office Health & Safety	☐Yes	☐No
Office Manager	☐Yes	☐No
Project Principal	☐Yes	☐No
Project Manager	☐Yes	☐No

REPORT TYPE: ☐ Loss ☐ Near Loss Estimated Costs: $ _____
____

OSHA CASE # Assigned by Corporate Health & Safety if Applicable:

Corporate Health & Safety Confirmed Final Accident Report
☐Yes ☐No

DATE OF INCIDENT: ________________

TIME INCIDENT OCCURRED: ____________ ☐AM ☐PM

INCIDENT LOCATION – City, State, and Country (If outside U.S.A.)
____

INCIDENT TYPES: (Select most appropriate if Loss occurred.)
From lists below, please select the option that best categories the incident. When selecting an injury or illness, also indicate the severity level.

☐**INJURY** ☐**ILLNESS**

------------------------**Severity Level**---------------------------

☐Fatality ☐First Aid ☐Medical Treatment
☐Restricted Work ☐Lost Time

OTHER INCIDENT TYPES

☐Spill / Release
Material involved: ________________
Quantity (U.S. Gallons): ____________

☐Misdirected Waste
☐Property Damage
☐Motor Vehicle

☐Consent Order
☐Exceedance
☐Fine / Penalty

☐NOV

ACTIVITY TYPE (Check most appropriate one.)

☐CAMP
☐Construction
☐Drilling
☐Driving
☐Excavation / Trenching
☐Gauging
☐O&M
☐Other Soil Work (e.g. Compaction)
☐Sampling
☐Site Walk/Inspection
☐Subsurface Clearance
☐Trucking
☐Waste Mgmt.
☐Work Area Prep.
☐Other

INJURY TYPE (Check all applicable.)

☐Abrasion
☐Amputation
☐Burn
☐Cold/Heat Stress
☐Inflammation
☐Laceration
☐Occupational Illness
☐Puncture
☐Rash
☐Repetitive Motion
☐Sprain/Strain
☐Other________

BODY PART AFFECTED (Check all applicable.)

☐Respiratory
☐Neck
☐Chest
☐Abdomen
☐Groin
☐Back
☐Shoulder
☐Arm
☐Wrist
☐Hand/Fingers
☐Eye
☐Head
☐Face
☐Leg
☐Knee
☐Ankle
☐Foot/Toes
☐Other______

I. PERSON(S) DIRECTLY / INDIRECTLY INVOLVED IN INCIDENT (Attach additional information as necessary/applicable.)

Name/Phone # of Each Person Directly/Indirectly Involved in Incident:	Designate: Roux/Remedial Employee Roux/Remedial Subcontractor Client Employee Client Contractor Third Party	As applicable, Current Occupation; Yrs in Current Occupation; Current Position; and Yrs in Current Position:	As applicable, Employer Name; Address; and Phone #:	As applicable, Supervisor Name; and Phone #:
1)				
2)				

II. PERSONS INJURED IN INCIDENT (Attach additional information as necessary/applicable.)

Name/Phone # of Each Person Injured in Incident:	Designate: Roux/Remedial Employee Roux/Remedial Subcontractor Client Employee Client Contractor Third Party	As applicable, Current Occupation; Yrs in Current Occupation; Current Position; and Yrs in Current Position:	As applicable, Employer Name; Address; and Phone #:	As applicable, Supervisor Name; and Phone #:	Description of Injury:
1)					
2)					

III. PROPERTY DAMAGED IN INCIDENT (Attach additional information as necessary/applicable.)

Property Damaged:	Property Location:	Owner Name, Address & Phone #:	Description of Damage:	Estimated Cost:
1)				
2)				$

IV. WITNESSES TO INCIDENT (Attach additional information as necessary/applicable.)

Witness Name:	Address:	Phone #:
1)		
2)		

PART 2: WHAT HAPPENED AND INCIDENT DETAILS

PROVIDE FACTUAL DESCRIPTION OF INCIDENT (e.g., describe loss/near loss, injury, response / treatment).

I. AUTHORITIES/GOVERNMENTAL AGENCIES NOTIFIED (Attach additional information as necessary/applicable.)

Authority/Agency Notified:	Name/Phone #/Fax # of Person Notified:	Address of Person Notified:	Date & Time of Notification:	Exact Information Reported/Provided:

II. PUBLIC RESPONSES TO INCIDENT (if applicable)

Response/Inquiry By: (check one)	Entity Name:	Name/Phone # of Respondent/ Inquirer:	Address of Entity/Person:	Date & Time of Response/Inquiry:
☐Newspaper ☐Television ☐Community Group ☐Neighbors ☐Other ________________				

Describe Response/Inquiry:

Roux/Remedial Response:

(Check all that apply.) (Attach photos, drawings, etc. to help illustrate the incident.)
ATTACHED INFORMATION: ☐Photo ☐Sketches ☐Vehicle Acord Form ☐Police Report ☐Other

Name(s) of person(s) who prepared Initial and Final Report:	**Title(s):**	**Phone number(s):**

PART 3: INVESTIGATION TEAM ANALYSIS

Date Investigation Started (MM/DD/YYYY):

Factors, Root Causes, and Solution (FRCS): Complete FRCS form and answer all 7 factor questions. If answering NO to Factors 1 – 4 identify root cause(s) and explain why QIs) occurred. If answering YES to Factors 5 – 7 circle the root cause(s). Transfer the solutions guidance that addresses each root cause from the FRCS form to this form. Attach your completed FRCS Worksheet. If Factors 1-7 do not apply to the incident, write "External Cause" in the Factor column below and leave the remaining fields blank.

DESCRIPTION OF UNDESIRABLE BEHAVIOR/CONDITION

1.

2.

FACTOR(S) AND SOLUTION(S): HOW TO REDUCE POSSIBILITY OF INCIDENT RECURRING

Selection of factors and solutions reflects the analysis of investigation team and is not meant to be a legally binding conclusion as to the Root Cause and/or solution.

CAUSAL FACTOR/ BEHAVIOR/ CONDITION	ROOT CAUSE	SOLUTION(S) [Must Match Root Cause(s)]	PERSON RESPONSIBLE	AGREED DUE DATE	ACTUAL COMPLETION DATE

INVESTIGATION TEAM:

PRINT NAME	JOB POSITION	DATE	SIGNATURE

QUALITY REVIEW Correct root cause(s) identified? Do root cause(s) and solution(s) match? Are solution(s) feasible / maintainable?

Name: **Job Title:**

PART 4: Date Solutions were Implemented & Validated (Were Solutions Effective?)

Date	Solution	Verifier / Validator Name and Job Title	Details (of I & V performed)

Appendix B – Near Loss Form

HEALTH & SAFETY NEAR LOSS
ROUX REPORT FORM

☐ **Roux Environmental Engineering and Geology, D.P.C.**
☐ **Roux Associates, Inc.** ☐ **Remedial Engineering, P.C.**

(Check applicable company name)

PART 1: ADMINISTRATIVE INFORMATION

Office: ☐ New York ☐ Massachusetts ☐ New Jersey ☐ Illinois ☐ CA - Los Angeles ☐ CA - Oakland

Project Manager:	**Project Principal:**
Project Name:	**Project Location:**

PART 2: NEAR LOSS INCIDENT DETAILS

Date\Time Occurred (MM/DD/YYYY HH:MM):	**Date\Time Submitted** (MM/DD/YYYY HH:MM):

NEAR LOSS INCIDENT TYPE - What could have happened? - Select all that apply (1-7)

1. ☐ Fire / Explosion 2. ☐ Injury / Illness	3. ☐ Security (e.g., theft, trespassing, vandalism)	4. ☐ Environmental (Spill, permit exceedance, etc.) 5. ☐ Transportation of personnel (vehicle accident)	6. ☐ Property/Equipment Damage 7. ☐ Business Interruption

Event Leading to Potential Injury/Illness:

Job Task*:	**Equipment Involved*:**

WHAT HAPPENED? Do not include individuals' names. Ensure photos, sketches, etc. are not personally identifiable unless written consent has been obtained.

Summary (1-2 sentences. Provide brief description of the incident. Provide facts only, no speculation or opinion)**:**

Incident Details (Brief factual details of what, where, when; include photos, sketches, etc. as attachments)**:**

Immediate Corrective Actions Taken:

SERIOUS INJURY OR FATALITY (SIF): IF AN ACTUAL SIF, USE EXISTING ROUX ACCIDENT REPORTING FORM

Could this have resulted in a SIF? ☐ **Yes** ☐**No**

A potential SIF is defined as likely to have caused an injury resulting in significant physical body damage with probable long term and/or life altering complications.

INCIDENT INVOLVED:

Roux Employee: ☐ **Yes** ☐ **No** **Subcontractor Company Name:**

INVESTIGATION TEAM

NAME	**JOB TITLE**	**NAME**	**JOB TITLE**

PART 3: INCIDENT INVESTIGATION FINDINGS AND REPORT QUALITY REVIEW

Date Investigation Started (mm/dd/yyyy):

Factors, Root Causes, and Solution (FRCS): Complete FRCS form and answer all 7 factor questions. If answering NO to Factors 1 – 4 identify root cause(s) and explain why QIs) occurred. If answering YES to Factors 5 – 7 circle the root cause(s). Transfer the solutions guidance that addresses each root cause from the FRCS form to this form. Attach your completed FRCS Worksheet. If Factors 1-7 do not apply to the incident, write "External Cause" in the Factor column below and leave the remaining fields blank. Do not include individuals' names.

DESCRIPTION OF UNDESIRABLE BEHAVIOR/CONDITION

1.

2.

FACTOR(S) AND SOLUTION(S): HOW TO REDUCE POSSIBILITY OF INCIDENT RECURRING
Selection of factors and solutions reflects the analysis of investigation team and is not meant to be a legally binding conclusion as to the Root Cause and/or solution.

Behavior / Condition	Root Cause	Solution(s) (Must Match Root Cause)	Person Responsible for Completion	Completion Target Date	Completion Actual Date

QUALITY REVIEW Correct root cause(s) identified? Do root cause(s) and solution(s) match? Are solution(s) feasible / maintainable?

Name: **Job Title:**

PART 4: Date Solutions were Implemented & Validated (Were Solutions Effective?)

Date	Solution	Verifier / Validator Name and Job Title	**Details** (of I & V performed)

***JOB TASK - Select the most appropriate one** (primary job associated with incident-related work activity, avoid "Other" if possible)

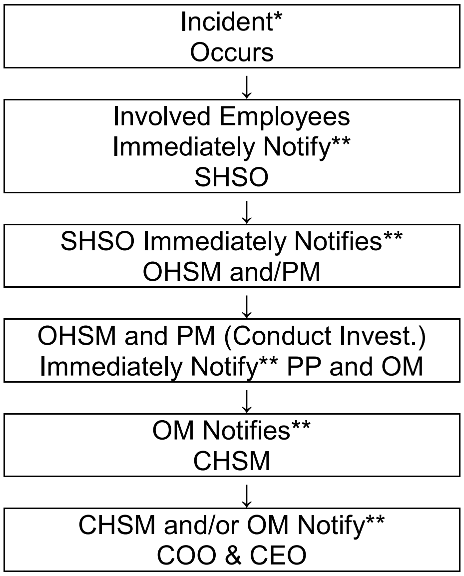
1. CAMP
2. Construction
3. Drilling
4. Driving
5. Excavation/Trenching
6. Gauging
7. O&M
8. Other Soil Work (e.g. Compaction)
9. Sampling
10. Site Walk/ Inspection
11. Subsurface Clearance
12. Trucking
13. Waste Management
14. Work Area Preparation
15. Other

***EQUIPMENT INVOLVED THAT CONTRIBUTED TO H&S NEAR LOSS - Select all that apply**

1. Air Stripper
2. API Separator
3. Automobile
4. Boom Material
5. Bulldozer
6. Cable
7. Carbon Drum / Vessel
8. Chain Block
9. Compressor, Air
10. Control Panel (local)
11. Crane (mobile)
12. Drill Rig
13. Drilling Equipment, Vacuum
14. Drum, Vertical
15. Dump Truck
16. Electric Heater
17. Electrical Power Supply
18. Engine, Combustion
19. Equipment Safety Grounding
20. Excavator / Power Shovel
21. Exclusion Zone Equipment
22 Fan / Blower
23 Fencing
24 Filter
25. Fire Extinguisher
26. Forklift
27. Front End Loader
28. Grader
29. Hammer
30. Knife
31. Non-Powered Equipment
32. Powered Equipment
33. Drill
34. Grinder
35. Hydraulic Torque Wrench
36. Powered Saw
37. Impact Wrench
38. Saw
39. Screwdriver
40. Shears
41. Shovel
42. Snip
43. Wrench
44. Hoist
45, Hook/Clamp/Buckle, etc.
46. Jack
47. Ladder, Extension
48. Ladder, Platform
49. Ladder, Step
50. Lock Out / Tag Out
51. Maintenance Tool, General
52. Manifold
53, Manlift/Basket/Cherry Picker
54. Motor, Electric
55. Oxidizer
56. Pallet
57. Piping
58. Piping, Hose
59. Piping, Injection/Mixing Point
60. Hydrojet
61. Centrifugal Pump
62. Diaphragm Pump
63. Reciprocating Pump
64. Regenerative Pump
65. Rotary Pump
66. Transfer Pump
67. Submersible Pump
68. Face Shield
69. Fall Protection
70. Gloves
71. Hard Hat / Helmet
72. Hearing Protection
73. Respiratory PPE (Chemical)
74. Respiratory PPE (Particulate)
75. Safety Glasses
76. Safety Goggles
77. Safety Shoes / Boots
78. Safety Vest / Clothing
79. Rope
80. Bailer
81. Geoprobe
82. Hand Auger
83. PID
84. Multi-Gas Meter
85. Sample Container
86. Split-Spoon Sampler
87. Sling
88. Snow Blower
89. Snow Plow
90. Space Heater
91. Air Sparging System
92. Carbon Treatment Sy
93. Chemical Oxidation S
94. Dual Phase Product Recovery System
95. Groundwater Pump and Treat System
96. POET System
97. Shed or Trailer
98. Vapor Extraction System
99. Vapor-Phase Treatment System
100. Other System, Type:____
101. Surge Tank
102. Underground Tank
103. Telemetry System
104. Testing Devices
105. Tractor Trailer
106. Truck, Flatbed
107. Truck, Pickup
108. Truck, Tank Truck
109. Truck, Vacuum
110. Safety Valve
111. Block Valve
112. Extraction Well
113. Monitoring Well
114. Recovery Well
115. Winch
116. Wire Rope
117. No Equipment Involved
118. MPT – Traffic Control Devices
118. Not in List (describe):____

Appendix C – Injury Illness Reporting Flow Chart

Health & Safety Near/Loss – Loss (Incident)*
Notification Flow Chart



* Incident – any work or site-related occurrence that resulted in, or could potentially have resulted in, the need for medical care or in property damage (i.e., all injuries or illnesses, exposure to toxic materials or any other significant occurrence resulting in property damage or in a "near loss")

** Verbal Notification

Initial Incident Report (written) to SHSO, OHSM, OM and CHSM within 24 hours
Follow-up Report within one week.