SENDERO VERDE REDEVELOPMENT PROJECT – PARCEL A
NEW YORK COUNTY
NEW YORK, NEW YORK

SITE MANAGEMENT PLAN

NYSDEC Site Number: C231135

Prepared for:

SV-A Owners LLC
Jonathan Rose Companies
551 Fifth Avenue, 23rd Floor
New York, New York 10176

Prepared by:

Roux Environmental Engineering and Geology, D.P.C.
209 Shafter Street
Islandia, New York 11749
631.232.2600

Revisions to Final Approved Site Management Plan:

Revision No.	Date Submitted	Summary of Revision	NYSDEC Approval Date

DECEMBER 2022

CERTIFICATION STATEMENT

I, Noelle Clarke, certify that I am currently a NYS registered professional engineer as defined in 6 NYCRR Part 375 and that this Site Management Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Noelle M. Clarke
No. 072491

__________________________ P.E.

December 28, 2022 DATE

SENDERO VERDE REDEVELOPMENT PROJECT- PARCEL A
NEW YORK COUNTY
NEW YORK, NEW YORK

SITE MANAGEMENT PLAN

TABLE OF CONTENTS

List of Tables

List of Figures

List of Plates

List of Appendices

A. Environmental Easement, Site Survey and Metes & Bounds Description
B. List of Site Contacts
C. Soil Boring and Monitoring Well Logs
D. Excavation Work Plan
E. Health and Safety Plan (including CAMP)
F. Quality Assurance Project Plan/ Field Sampling Plan
G. Site Management Forms
H. Responsibilities of Owner and Remedial Party

LIST OF ACRONYMS

AS	Air Sparging
ASP	Analytical Services Protocol
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CAMP	Community Air Monitoring Plan
C/D	Construction and Demolition
CFR	Code of Federal Regulation
CLP	Contract Laboratory Program
COC	Certificate of Completion
CO2	Carbon Dioxide
CP	Commissioner Policy
CVOCs	Chlorinated Volatile Organic Compounds
DER	Division of Environmental Remediation
EC	Engineering Control
ECL	Environmental Conservation Law
ELAP	Environmental Laboratory Approval Program
ERP	Environmental Restoration Program
EWP	Excavation Work Plan
GHG	Green House Gas
GWE&T	Groundwater Extraction and Treatment
HASP	Health and Safety Plan
IC	Institutional Control
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Codes, Rules and Regulations
O&M	Operation and Maintenance
OM&M	Operation, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PGSCOs	Protection of Groundwater Soil Cleanup Objectives
PRP	Potentially Responsible Party
PRR	Periodic Review Report
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RP	Remedial Party
RRSCOs	Restricted Residential Soil Cleanup Objectives

RUSCOs	Residential Use Soil Cleanup Objectives
SAC	State Assistance Contract
SCG	Standards, Criteria and Guidelines
SCO	Soil Cleanup Objective
SMP	Site Management Plan
SOP	Standard Operating Procedures
SOW	Statement of Work
SPDES	State Pollutant Discharge Elimination System
SRIWP	Supplemental Remedial Investigation Work Plan
SSD	Sub-slab Depressurization
SVE	Soil Vapor Extraction
SVI	Soil Vapor Intrusion
SVOCs	Semivolatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UUSCOs	Unrestricted Use Soil Cleanup Objectives
VCA	Voluntary Cleanup Agreement
VCP	Voluntary Cleanup Program
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

The following provides a brief summary of the institutional and engineering controls (ICs and ECs) implemented on the portions of the Sendero Verde Redevelopment Project – Parcel A site that achieved Track 2 or Track 4 remedial action objectives, as well as the inspections, monitoring, maintenance and reporting activities required by this Site Management Plan (SMP):

Site Identification:	C231135, Sendero Verde Redevelopment Project - Parcel A
Institutional and Engineering Controls for the Track 2 Restricted Residential and Track 4 Portions of the Site:	1. The property may be used for restricted residential, commercial, or industrial use.
	2. All ECs must be operated and maintained as specified in this SMP.
	3. All ECs must be inspected and certified at a frequency and in a manner defined in the SMP.
	4. Use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the New York State Department of Health or the New York City Department of Health and Mental Hygiene to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the New York State Department of Environmental Conservation.
	5. Groundwater and other environmental or public health monitoring must be performed as defined in the SMP.
	6. Data and information pertinent to Site Management must be reported at the frequency and in a manner defined in the SMP.

	7. All future activities on the property that will disturb remaining contaminated material must be conducted in accordance with the SMP. The potential for vapor intrusion must be evaluated for any future buildings (excluding the buildings currently under construction at the time this SMP was issued) developed in the area within the IC boundaries noted on Figure 5, and appropriate actions to address exposures must be implemented. Vegetable gardens and farming are prohibited, with the exception of raised planting beds.
	8. Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in the SMP.
	9. Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical components of the remedy shall be performed as defined in the SMP.
	10. Access to the site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by the Environmental Easement.
Engineering Controls for the Track 4 Portion of the Site:	Cover system
Inspections:	**Frequency**
1. Cover Inspection:	Annually

Monitoring:	Not applicable
Maintenance:	As needed
Reporting:	
1. Periodic Review Report	First Periodic Review Report due after the first 16-month certification period, then annually until completion and documentation of all development-related construction, then every three years thereafter upon approval of NYSDEC.

Further descriptions of the above requirements are provided in detail in the latter sections of this Site Management Plan.

1.0 INTRODUCTION

1.1 General

This Site Management Plan (SMP) is a required element of the remedial program for the Sendero Verde Redevelopment Project- Parcel A located in the Borough of Manhattan, City and State of New York (hereinafter referred to as the "Site"). See Figure 1. The Site is currently in the New York State (NYS) Brownfield Cleanup Program (BCP), Site No. C231135, which is administered by New York State Department of Environmental Conservation (NYSDEC).

SV-A Owners LLC entered into a Brownfield Cleanup Agreement (BCA), Index No. C231135-09-19, with the NYSDEC on November 12, 2019 to remediate the Site. BCA Amendment No. 1 was executed on September 15, 2021 to reflect the change in legal ownership of the Site from "The City of New York Acting by and through its Department of Housing Preservation and Development" to "Acacia Sendero Verde Housing Development Fund Company, Inc." BCA Amendment No. 2 was executed on December 27, 2022 to (1) add the non-applicant, "SV-A Moderate Owners LLC," to the BCA as the beneficial and equitable owner of the BCP Site, pursuant to a Nominee Agreement with the current Fee Owner of the BCP Site, "Acacia Sendero Verde Housing Development Fund Corporation." and (2) add the existing Volunteer, "SV-A Owners LLC," to the BCA as a long-term lessee, pursuant to a Master Lease with the current Beneficial Owner of the BCP Site, "SV-A Moderate Owners LLC" (Note: "SV-A Owners LLC" is already on the BCA as the sole Remedial Party/Volunteer, and it will remain the sole Remedial Party/Volunteer).

The Site location and boundaries are depicted in Figure 2. The boundaries of the Site are more fully described in the metes and bounds Site description that is part of the Environmental Easement provided in Appendix A.

After completion of the remedial work, some contamination was left at this Site, which is hereinafter referred to as "remaining contamination." Institutional Controls (ICs) and an Engineering Control (EC) have been incorporated into the Site remedy to control exposure to remaining contamination to ensure protection of public health and the environment. An

Environmental Easement granted to the NYSDEC and recorded with the New York City Office of the City Register requires compliance with this SMP and all ECs and ICs placed on the Site.

This SMP was prepared to manage remaining contamination at the Site until the Environmental Easement is extinguished in accordance with ECL Article 71, Title 36. This plan has been approved by the NYSDEC, and compliance with this plan is required by the grantor of the Environmental Easement and the grantor's successors and assigns. This SMP may only be revised with the approval of the NYSDEC.

It is important to note that:

- This SMP details the Site-specific implementation procedures that are required by the Environmental Easement. Failure to properly implement the SMP is a violation of the Environmental Easement, which is grounds for revocation of the Certificate of Completion (COC);
- Failure to comply with this SMP is also a violation of Environmental Conservation Law, 6 NYCRR Part 375 and the BCA (Index #C231135-09-19; Site #C231135) for the Site, and thereby subject to applicable penalties.

All reports associated with the Site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State. A list of contacts for persons involved with the Site is provided in Appendix B of this SMP.

This SMP was prepared by Roux Environmental Engineering and Geology, D.P.C. (Roux), on behalf of SV-A Owners LLC, in accordance with the requirements of the NYSDEC's DER-10 ("Technical Guidance for Site Investigation and Remediation"), dated May 2010 and the guidelines provided by the NYSDEC. This SMP addresses the means for implementing the ICs and/or EC that are required by the Environmental Easement for the Site.

1.2 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. The NYSDEC can also make changes to the SMP or request revisions from the remedial party. Revisions will be necessary upon, but not limited to, the following occurring: a change in media monitoring requirements, upgrades to or shut-down of a remedial system, post-remedial removal of contaminated sediment or soil, or other significant change to the

Site conditions. In accordance with the Environmental Easement for the Site, the NYSDEC project manager will provide a notice of any approved changes to the SMP and append these notices to the SMP that is retained in its files.

1.3 Notifications

Notifications will be submitted by the property owner to the NYSDEC, as needed, in accordance with NYSDEC's DER – 10 for the following reasons:

1. 60-day advance notice of any proposed changes in Site use that are required under the terms of the BCA, 6 NYCRR Part 375 and/or Environmental Conservation Law.
2. 7-day advance notice of any field activity associated with the remedial program.
3. 15-day advance notice of any proposed ground-intrusive activity pursuant to the Excavation Work Plan. If the ground-intrusive activity qualifies as a change of use as defined in 6 NYCRR Part 375, the above mentioned 60-day advance notice is also required.
4. Notice within 48-hours of any damage or defect to the foundation, structures or EC that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.
5. Notice within 48 hours of any non-routine maintenance activities.
6. Verbal notice by noon of the following day of any emergency, such as a fire, flood, or earthquake, that reduces or has the potential to reduce the effectiveness of an EC in place at the Site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.
7. Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action submitted to the NYSDEC within 45 days of the emergency event describing and documenting actions taken to restore the effectiveness of the EC.

Any change in the ownership of the Site or the responsibility for implementing this SMP will include the following notifications:

1. At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser/Remedial Party has been provided with a copy of the BCA and all approved work plans and reports, including this SMP.
2. Within 15 days after the transfer of all or part of the Site, the new owner's name, contact representative, and contact information will be confirmed in writing to the NYSDEC.

Table 1 on the following page includes contact information for the above notifications. The information on this table will be updated as necessary to provide accurate contact information. A full listing of Site-related contact information is provided in Appendix B.

Table 1: Notifications*

Name	Contact Information	Required Notification**
Steven Wu, NYSDEC Project Manager	Phone: (718) 482-6725 email: steven.wu@dec.ny.gov	All Notifications
Andre A. Obligado, NYSDEC Section Chief	phone: (718) 482-6412 email: andre.obligado@dec.ny.gov	All Notifications
Kelly Lewandowski, NYSDEC Site Control Section Chief	phone: (518) 402-9569 email: kelly.lewandowski@dec.ny.gov	Notifications 1 and 8
Mark Sergott, NYSDOH Project Manager	Phone: (518) 402-7897 Email: mark.sergott@health.ny.gov	Notifications 4, 6, and 7

* Note: Notifications are subject to change and will be updated as necessary.

** Note: Numbers in this column reference the numbered bullets in the notification list in this section.

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

2.1 Site Location and Description

The Site is located in the Borough of Manhattan, City and State of New York and is identified as Section Manhattan Block 1617 and Lot 120 on the New York City Tax Map (see Figure 2). As described previously, BCA Amendment No. 1 was executed on September 15, 2021 to address the change in legal ownership of the Site from "The City of New York Acting by and through its Department of Housing Preservation and Development" to "Acacia Sendero Verde Housing Development Fund Company, Inc.". BCA Amendment No. 2 was executed on December 27, 2022 to (1) add the non-applicant, "SV-A Moderate Owners LLC," to the BCA as the beneficial and equitable owner of the BCP Site, pursuant to a Nominee Agreement with the current Fee Owner of the BCP Site, "Acacia Sendero Verde Housing Development Fund Corporation" and (2) add the existing Volunteer, "SV-A Owners LLC," to the BCA as a long-term lessee, pursuant to a Master Lease with the current Beneficial Owner of the BCP Site, "SV-A Moderate Owners LLC" (Note: "SV-A Owners LLC" is already on the BCA as the sole Remedial Party/Volunteer, and it will remain the sole Remedial Party/Volunteer).

The Site is currently undergoing redevelopment. Most recently, the Site was utilized as community gardens, which were vacated in February 2018. The Site is located in a mixed-use area of East Harlem, Manhattan, New York. There are multiple high-rise residential buildings located to the north beyond East 112th Street; to the west, beyond Madison Avenue, is a multi-family residential building; to the south are Block 1617 Lot 21 (which includes a four story commercial building), a portion of Lot 7502 and Lot 125, East 111th Street and multiple mixed use commercial and residential high-rise buildings; to the east is the main portion of the Sendero Verde Redevelopment Project – Parcel B on Lot 7502 (SV-B), which is currently under construction, beyond which is Park Avenue, the elevated Metro North Railroad Tracks and a playground belonging to a public school (see Figure 2 – Site Layout Map). The boundaries of the Site are more fully described in Appendix A – Environmental Easement. The owners of the Site parcels at the time of issuance of this SMP is/are:

- Fee Owner - Acacia Sendero Verde Housing Development Fund Company, Inc.
- Beneficial Owner - SV-A Moderate Owners LLC

2.2 Physical Setting

2.2.1 Land Use

Prior to the remedial action, the Site consisted of the following: an unpaved vacant lot surrounded by chain-link fence that was formerly used as a community garden. The Site is currently zoned for commercial (C2-5) and residential (R-9) use and was vacant prior to the start of remedial activities. Prior to the community garden, previous Site occupants included Scaffaldi Geo Shoe Repair, Jalisco Express, Hy-Grade Electric Company, Mohawk Fuel Company (likely an office based on other lines of evidence reviewed), Contreras Hernando Shoes, A&M Floor Covering Company, Morton Pharmacy, and Falit Jack Dry Goods.

The properties adjoining the Site, and in the neighborhood surrounding the Site, primarily include commercial and residential properties. The properties immediately south of the Site include commercial and residential properties; the properties immediately north of the Site include residential properties; the properties immediately east of the Site include commercial and residential properties (which are part of the overall Sendero Verde Redevelopment Project); and the properties immediately west of the Site include residential properties.

2.2.2 Geology

The grade at the Site is relatively flat. The elevation of the Site and surrounding area is approximately 18 feet above mean sea level (amsl).

Based on the investigations completed on-Site to date, the shallow deposits at the Site are typical of historic fill material found in urban environments such as New York City (i.e., brick and concrete). The depth to the bottom of the fill layer extends to between five and 13 feet (ft) below land surface (bls) across the Site, with localized areas of fill up to 20 ft bls. This urban fill material overlies deeper native deposits consisting of mostly fine to coarse sands and gravel with varying amounts of sand, silt, and clay. Bedrock was not encountered during the Roux Phase II Environmental Site Assessment (ESA) or the completed Remedial Investigation (RI).

A geologic cross section/generalized cut and fill map is shown in Figure 3. Site specific boring logs are provided in Appendix C.

2.2.3 Hydrogeology

According to water-level data collected during the RI the elevation of the water table surface at the Site ranges from approximately 4.41 ft North American Vertical Datum of 1988 (NAVD 88) at the southwest portion of the Site to approximately 4.88 NAVD 88 in the northwest portion of the Site. Groundwater depth at the Site varied from 12.00 ft bls to 13.60 ft bls. Groundwater flow is generally to the southeast towards the Harlem River which is located approximately 3,300 feet east of the Site.

A groundwater contour map is shown in Figure 4. Groundwater elevation data is provided in Table 2. Groundwater monitoring well construction logs are provided in Appendix C.

2.3 Investigation and Remedial History

The following narrative provides a history timeline and a brief summary of the available project records to document key investigative and remedial milestones for the Site. Full titles for each of the reports referenced below are provided in Section 8.0 - References.

The following environmental reports were available for review:

- Phase I ESA, prepared by Roux, dated March 2018.
- Phase II ESA, prepared by Roux, dated June 2018.
- Amendment to the Phase II ESA, prepared by Roux, dated November 13, 2018.
- Waste Characterization Soil Sampling Letter Report, prepared by Roux, dated February 18, 2019.
- Remedial Investigation Report / Remedial Action Work Plan, prepared by Roux, dated May 2021.

Historic Site Use

According to a review of the historical aerial photographs, the Site appears to have been developed since at least 1924 with several Site buildings, which corroborates the historical development conditions as shown in the Certified Sanborn Fire Insurance maps.

Demolition of several Site buildings is first shown in the 1975 aerial photograph. The 1984 aerial photograph shows demolition of additional Site buildings. The 1991 aerial photograph shows all Site buildings demolished. The general site layout appeared generally consistent between 1991 and the demolition of the garden structures in 2018. The City Directory Abstract also included listings for the surrounding properties. As indicated by the City Directory, 56 East 112th Street, which is located east of the Site and is part of SV-B, operated as Continental Tailors & Cleaners (assumed to be a dry cleaner) in 1968. Other noted operators/tenants of Lot 20 included White Printer Department, Hyman Furrier, Jonas Drug Company, Schweitzer Isaac Jennie Shoe Repair, Krals Novelty Shoe Co, and Hirsch Brandel Shoes.

The following section summarizes soil, groundwater, and soil vapor quality data that was generated by Roux during the RI (comprised of the 2018 Phase II ESA, 2019 waste characterization sampling program, and 2020 SRI):

- Based on the Site-wide detections and exceedances of NYSDEC Unrestricted Use Soil Cleanup Objectives (UUSCOs) (and/or guidance values for perfluorooctanesulfonic acid [PFOS] and perfluorooctanoic acid [PFOA]), soil at the Site was impacted with SVOCs (exclusively polycyclic aromatic hydrocarbons [PAH]s), metals, pesticides/herbicides, PCBs, PFOS and PFOA, likely due to urban fill materials across the Site.
- Groundwater was not significantly impacted. Only two VOCs (PCE and chloroform) were detected in groundwater above the applicable NYSDEC AWQSGVs, but at relatively low concentrations. VOC exceedances of NYSDEC PGWSCOs in soil were limited to only acetone (i.e., a typical lab contaminant); therefore, no on-Site source of VOCs was identified.
- Some PAHs were identified in both soil and groundwater. However, it is likely that SVOCs present in the unfiltered groundwater samples were a result of suspended sediment present in the samples and are not representative of dissolved impacts in groundwater. This data indicates that SVOCs in soil were not a significant source of groundwater contamination at the Site. Heavy metals with corresponding exceedances in soil were not observed in groundwater.
- PFAS compounds were detected in both soil (only within the fill layer) and groundwater. There was no documented use of PFAS at the Site and no known historical Site use that would indicate the past use of these compounds (i.e., historical uses only included stores and residential dwellings). Therefore, the presence of PFAS was likely due to background levels of these compounds in New York City, and they are not considered contaminants of concern for the Site.

- Based on the Site-wide detections, soil vapor at the Site was impacted with VOCs, though at relatively low concentrations not indicative of an on-Site source. Soil vapor impacts likely originated from off-Site sources as no on-Site source of VOCs was identified in soil. Two chlorinated VOCs (PCE and chloroform) were found in both soil vapor and groundwater. Chloroform was found in SVA-MW-2 and SVA-MW-4 in groundwater, but in soil vapor it was found in SVA-SV-4, SVA-SV-5 and SVA-SV-6.
- There was no on-Site source for the VOCs in soil vapor identified during the RI. It is possible the chlorinated VOCs in groundwater (likely from an off-Site source) were contributing to soil vapor concentrations. The highest concentrations of PCE and TCE in soil vapor were observed in the central portion of the Site at SVA-SV-5. Soil vapor concentrations at the perimeter of the Site were non-detect (southern and eastern portions of the Site) or low (northern and western portions), and off-Site migration is not a concern. Although the source of the chloroform could not be confirmed, the presence of chloroform in groundwater and soil vapor may be attributed to potentially leaking plumbing related to the former on-Site structures, leaking water mains and/or the watering of the community gardens with potable water that was likely chlorinated.

2.4 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the Site as listed in the Decision Document dated May 2021 are as follows:

Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.

RAOs for Environmental Protection

- Remove the source of ground or surface water contamination.

Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil.
- Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

Soil Vapor

RAOs for Public Health Protection

- Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a Site.

Remedial Action Elements

The selected remedy is referred to as the Excavation and Partial Site Cover remedy. The following list summarizes the elements of the remedial action performed in accordance with the Site's Decision Document issued by NYSDEC:

- A remedial design program implemented to provide the details necessary for the construction, operation, optimization, maintenance, and monitoring of the remedial program. Green remediation principles and techniques implemented to the extent feasible in the design, implementation, and Site management of the remedy as per DER 31. The major green remediation components are as follows:
    - Considering the environmental impacts of treatment technologies and remedy stewardship over the long term;
    - Reducing direct and indirect greenhouse gases and other emissions;
    - Increasing energy efficiency and minimizing use of non-renewable energy;
    - Conserving and efficiently managing resources and materials;
    - Reducing waste, increasing recycling and increasing reuse of materials which would otherwise be considered a waste;
    - Maximizing habitat value and creating habitat when possible;
    - Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and
    - Integrating the remedy with the end use where possible and encouraging green; and
    - Sustainable redevelopment.
    - Additionally, to incorporate green remediation principles and techniques to the extent feasible in the future development at this Site, any future on-site buildings will include, at a minimum, a 20-mil vapor barrier/waterproofing membrane on the foundation to improve energy efficiency as an element of construction.

- Excavation and off-site disposal of all on-site soils which exceed unrestricted SCOs as defined by 6 NYCRR Part 375-6.8 in the Track 1 areas of the site. Excavation and off-site disposal of all on-site soils which exceed restricted residential SCOs as defined by 6 NYCRR Part 375-6.8 in the upper 15 feet in the Track 2 areas of the site. Where a Track 1 or Track 2 cleanup is achieved, a Cover System will not be a required element of the remedy in those locations. Excavation and off-site disposal of all on-site soils which exceed restricted residential SCOs as defined by 6 NYCRR Part 375-6.8 in the upper 2 feet in the Track 4 portion of the site. Approximately 9,965.46 cubic yards (13,951.65 tons) of non-hazardous soil was excavated and removed from the Site.
- Clean fill meeting the requirements of 6 NYCRR Part 375-6.7(d) brought in to replace the excavated soil and/or complete the backfilling of the excavation and establish the designed grades at the Site. Approximately 1,584.4 cubic yards of NYSDEC-approved backfill was imported to the Site.
- Groundwater extraction and treatment implemented to facilitate remedial excavation. The extracted groundwater was treated using prior to discharge to the municipal sewer. Approximately 730,000-gallons of groundwater was treated on-Site using a temporary on-Site settling tank and discharged to the combined sewer pursuant to a de-watering permit issued by the New York City Department of Environmental Protection (NYCDEP).
- A site cover was required in the Track 4 area of the Site to allow for restricted residential use of the site in areas where the upper two feet of exposed surface soil exceed the applicable soil cleanup objectives (SCOs). Where a soil cover was used it was a minimum of two feet of soil placed over a demarcation layer, with the upper six inches of soil of sufficient quality to maintain a vegetative layer. Soil cover material, including any fill material brought to the site, will meet the SCOs for cover material for the use of the site as set forth in 6 NYCRR Part 375-6.7(d). Substitution of other materials and components may be allowed where such components already exist or are a component of the tangible property to be placed as part of site redevelopment. Such components may include, but are not necessarily limited to: pavement, concrete, paved surface parking areas, sidewalks, building foundations and building slabs.
- As part of the remedy, a soil vapor intrusion evaluation was completed. The evaluation included a provision for implementing actions recommended to address exposures related to soil vapor intrusion.
- Imposition of an institutional control in the form of an Environmental Easement for the portions of the Site that did not achieve a Track 1 unrestricted use cleanup or a Track 2 residential cleanup which:
    - requires the remedial party or site owner to complete and submit to the NYSDEC a periodic certification of institutional and engineering controls in accordance with Part 375-1.8 (h)(3);

  - allows the use and development of the controlled property for restricted residential, commercial or industrial uses as defined by Part 375-1.8(g), although land use is subject to local zoning laws;
  - restricts the use of groundwater as a source of potable or process water, without necessary water quality treatment as determined by the NYSDOH or the NYCDOHMH; and
  - requires compliance with the NYSDEC-approved Site Management Plan.
- A Site Management Plan (SMP) is required for all portions of the Site that did not achieve a Track 1 unrestricted use cleanup or a Track 2 residential use cleanup which includes the following:

  a) an Institutional and Engineering Control Plan that identifies all use restrictions and engineering controls for the site and details the steps and media specific requirements necessary to ensure the following institutional and/or engineering controls remain in place and effective:
  - Institutional Controls: The Environmental Easement for the Track 2 Restricted Residential area of the site and the Track 4 area of the Site discussed above; and
  - Engineering Controls: The cover system for the Track 4 area of the Site discussed above.

2.5 Remaining Contamination

The remaining contamination after the remedial action was completed is limited to soil in the areas where a Track 1 Unrestricted Use cleanup was not achieved. Limited northwestern and eastern portions of the Site achieved Track 2 Restricted Residential Use or Residential Use cleanups, respectively, and the southern portion of the Site achieved a Track 4 Restricted Residential Use cleanup through the implementation of EC (Site Cover System) where UUSCOs were exceeded. The remainder of the Site met Track 1 UUSCOs. Based on the endpoint samples collected during the remedial action, the remaining contamination is limited primarily to a subset of certain SVOCs, metals, and pesticides. All remaining contamination is located under the building foundation slab. For the areas where Track 1 UUSCOs or Track 2 RSCOs were not achieved, long-term management of the EC/ICs and remaining contamination will be performed in accordance with this SMP. The areas of the **S**ite that achieved Track 2 and Track 4 cleanups are shown on Figure 5**.**

Tables 3 through 8 and Plate 1 summarize the results of endpoint soil samples collected that exceed the UUSCOs, RSCOs and/or RRSCOs at the Site after completion of remedial action.

3.0 INSTITUTIONAL AND ENGINEERING CONTROL PLAN

3.1 General

Because remaining contamination exists at the site, Institutional Controls (ICs) and an Engineering Control (EC) are required to protect human health and the environment. This IC/EC Plan describes the procedures for the implementation and management of all ICs/EC at the Site. The IC/EC Plan is one component of the SMP and is subject to revision by the NYSDEC.

This Plan provides:

- A description of all ICs/EC on the Site;
- The basic implementation and intended role of each IC/EC;
- A description of the key components of the ICs set forth in the Environmental Easement;
- A description of the controls to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of ICs/EC, such as the implementation of the Excavation Work Plan (EWP) (as provided in Appendix D) for the proper handling of remaining contamination that may be disturbed during maintenance or redevelopment work on the Site; and
- Any other provisions necessary to identify or establish methods for implementing the ICs/EC required by the Site remedy, as determined by the NYSDEC.

These IC/ECs stated in the Environmental Easement include:

- The property may be used for restricted residential, commercial, or industrial use.
- All ECs must be operated and maintained as specified in this SMP.
- All ECs must be inspected and certified at a frequency and in a manner defined in the SMP.
- Use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the NYCDOHMH to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the NYSDEC.
- Groundwater and other environmental or public health monitoring must be performed as defined in the SMP.
- Data and information pertinent to Site Management must be reported at the frequency and in a manner defined in the SMP.

- All future activities on the property that will disturb remaining contaminated material must be conducted in accordance with the SMP. The potential for vapor intrusion must be evaluated for any future buildings (excluding the buildings currently under construction at the time this SMP was issued) developed in the area within the IC boundaries noted on Figure 5, and appropriate actions to address exposures must be implemented. Vegetable gardens and farming are prohibited, with the exception of raised planting beds.
- Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in the SMP.
- Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical components of the remedy shall be performed as defined in the SMP.
- Access to the site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by the Environmental Easement.

3.2 Institutional Controls

A series of ICs is required by the RAWP to: (1) implement, maintain and monitor Engineering Control systems; (2) prevent future exposure to remaining contamination; and (3) limit the use and development of the Site to restricted residential, commercial or industrial uses only. Adherence to these ICs on the Site is required by the Environmental Easement and will be implemented under this SMP. ICs identified in the Environmental Easement may not be discontinued without an amendment to or extinguishment of the Environmental Easement as approved by the NYSDEC. The IC boundaries are shown on Figure 5.

3.3 Engineering Controls

3.3.1 Site Cover System

Exposure to remaining contamination (Plate 1) in the Track 4 area of the Site will be prevented by an engineered Site Cover System constructed on the Site (Plate 2). This Site Cover System is comprised of concrete building foundations. Although not a required EC, to incorporate green remediation principles, a vapor barrier/waterproofing membrane was installed as an element of construction throughout the area occupied by the footprint of the new building and up the foundation sidewalls in accordance with manufacturer specifications. The Site Cover System for the concrete building foundation is comprised of a crushed stone subbase and concrete foundation slab, with a demarcation layer between the concrete and waterproofing/vapor barrier.

Plate 2 presents the location of the Site Cover System and applicable demarcation layers. The Excavation Work Plan (EWP) provided in Appendix D outlines the procedures required to be implemented in the event the Site Cover System is breached, penetrated or temporarily removed. Procedures for the inspection of this Cover are provided in the Monitoring and Sampling Plan included in Section 4.0 of this SMP. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in the Health and Safety Plan (HASP) and associated Community Air Monitoring Plan (CAMP) prepared for the Site and provided in Appendix E. Any disturbance of the Site Cover System must be overseen by a qualified environmental professional as defined in 6 NYCRR Part 375, a Professional Engineer (PE) who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State.

3.3.2 Criteria for Completion of Remediation/Termination of Remedial Systems

Generally, remedial processes are considered completed when monitoring indicates that the remedy has achieved the remedial action objectives identified by the Decision Document. The framework for determining when remedial processes are complete is provided in Section 6.4 of NYSDEC DER-10.

3.3.2.1 – Site Cover System

The composite Site Cover System is a permanent control, and the quality and integrity of this System will be inspected at defined, regular intervals in accordance with this SMP in perpetuity.

4.0 MONITORING PLAN

4.1 General

This Monitoring Plan describes the measures for evaluating the overall performance and effectiveness of the remedy. This Monitoring Plan may only be revised with the approval of the NYSDEC.

This Monitoring Plan describes the methods to be used for:

- Monitoring the EC; and
- Evaluating Site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment.

To adequately address these issues, this Monitoring Plan provides information on:

- Annual inspection and periodic certification.

Reporting requirements are provided in Section 7.0 of this SMP.

4.2 Site–Wide Inspection

Site-wide inspections will be performed at a minimum of once per year. These periodic inspections must be conducted when the ground surface is visible (i.e., no snow cover). Site-wide inspections will be performed by a qualified environmental professional as defined in 6 NYCRR Part 365, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York State. Modification to the frequency or duration of the inspections will require approval from the NYSDEC project manager. Site-wide inspections will also be performed after all severe weather conditions that may affect ECs or monitoring devices. During these inspections, an inspection form will be completed as provided in Appendix G – Site Management Forms. The form will compile sufficient information to assess the following:

- Compliance with all ICs, including Site usage;
- Evaluation of the condition and continued effectiveness of the EC;
- General Site conditions at the time of the inspection;
- Whether stormwater management systems, such as basins and outfalls, are working as designed;

- The Site management activities being conducted, including, where appropriate, confirmation sampling and a health and safety inspection; and
- Confirmation that Site records are up to date.

Inspections of all remedial components installed at the Site will be conducted. A comprehensive Site-wide inspection will be conducted and documented according to the SMP schedule, regardless of the frequency of the Periodic Review Report. The inspections will determine and document the following:

- Whether the EC continues to perform as designed;
- Whether the EC continues to be protective of human health and the environment;
- Compliance with requirements of this SMP and the Environmental Easement;
- Achievement of remedial performance criteria; and
- Whether Site records are complete and up to date.

Reporting requirements are outlined in Section 7.0 of this plan.

Inspections will also be performed in the event of an emergency. If an emergency, such as a natural disaster or an unforeseen failure of any of the EC occurs that reduces or has the potential to reduce the effectiveness of the EC in place at the Site, verbal notice to the NYSDEC project manager must be given by noon of the following day. In addition, an inspection of the Site will be conducted within 5 days of the event to verify the effectiveness of the ICs/EC implemented at the Site by a qualified environmental professional, as defined in 6 NYCRR Part 375. Written confirmation must be provided to the NYSDEC project manager within 7 days of the event that includes a summary of actions taken, or to be taken, and the potential impact on the environment and the public.

4.3 Treatment System Monitoring and Sampling

There are no active ECs; therefore, Treatment System Monitoring and Sampling is not included in this SMP.

4.4 Post-Remediation Media Monitoring and Sampling

There is no media to be monitored and sampled after the remediation is completed; therefore, it is not included in this SMP. The remedial elements including excavation and the Site Cover System addressed remaining soil contamination in the Track 2 and Track 4 portions of the Site. An EWP is included as Appendix D in the event that future excavation and/or import or reuse of soil is required. Based on the RI data, groundwater is not significantly impacted and is not used for drinking or other potable uses, and there is no direct contact with or ingestion by the general public. Based on an evaluation included in the FER of the soil vapor data from the RI, there was no soil vapor intrusion issue prior to the remedy, and there was no on-Site source identified during the remediation. Therefore, there is no current vapor intrusion risk for the buildings currently under construction at the time this SMP was issued.

The potential for vapor intrusion will be evaluated for any future buildings (excluding the buildings currently under construction at the time this SMP was issued) developed in the area within the IC boundaries noted on Figure 5, and appropriate actions to address exposures must be implemented.

5.0 OPERATION AND MAINTENANCE PLAN

5.1 General

The Site remedy does not rely on any mechanical systems, such as groundwater treatment systems, sub-slab depressurization systems or air sparge/soil vapor extraction systems to protect public health and the environment. Therefore, the operation and maintenance of such components is not included in this SMP. The Site Cover system may need periodic maintenance/repairs based on the observed condition of the cover elements.

6.0 PERIODIC ASSESSMENTS/EVALUATIONS

6.1 Climate Change Vulnerability Assessment

Increases in both the severity and frequency of storms/weather events, an increase in sea level elevations along with accompanying flooding impacts, shifting precipitation patterns and wide temperature fluctuation, resulting from global climactic change and instability, have the potential to significantly impact the performance, effectiveness and protectiveness of a given site and associated remedial systems. Vulnerability assessments provide information so that the site and associated remedial systems are prepared for the impacts of the increasing frequency and intensity of severe storms/weather events and associated flooding.

This section provides a summary of vulnerability assessments that will be conducted for the Site during periodic assessments, and briefly summarizes the vulnerability of the Site and/or EC to severe storms/weather events and associated flooding.

- Flood Plain: The Site is not located in a flood plain, low-lying or low-groundwater recharge area.
- Site Drainage and Storm Water Management: During construction, adequate storm management systems were constructed for the building and Site; therefore, flooding is not anticipated.
- Erosion: The Site is capped by a building, therefore, erosion at the Site is not anticipated.
- High Wind: The Site is not susceptible to damage from the wind itself or from falling objects, such as trees or utility structures during periods of high wind.
- Electricity: Power loss, dips and/or surges in voltage during severe weather events, including lightning strikes, and the associated impact on Site equipment and operations are not anticipated.
- Spill/Contaminant Release: No areas of the Site have been identified that may be susceptible to a spill or other containment release due to storm-related damage caused by flooding, erosion, high winds, loss of power, etc.

6.2 Green Remediation Evaluation

NYSDEC's DER-31 Green Remediation requires that green remediation concepts and techniques be considered during all stages of the remedial program including Site management, with the goal of improving the sustainability of the cleanup and summarizing the net environmental benefit of any implemented green technology. This section of the SMP provides a summary of green remediation evaluations completed for the Site.

Green remediation principles and techniques were implemented to the extent feasible in the design, implementation, and Site management of the remedy per DER-31. The primary green remediation principles incorporated into the Site's remediation are as follows:

a. Consideration of the environmental impacts of treatment technologies and remedy stewardship over the long term;
b. Reduction of direct and indirect greenhouse gases and other emissions;
c. Increase in energy efficiency and minimizing use of non-renewable energy;
d. Conservation and efficient management of resources and materials;
e. Reduction of waste and increase in recycling and reuse of materials which would otherwise be considered a waste;
f. Maximization of habitat value and creation of habitat when possible;
g. Fostering green and healthy communities and working landscapes which balance ecological, economic and social goals; and
h. Integration of the remedy with the end use where possible and encouragement of green and sustainable re-development.

In addition, to further incorporate green remediation principles and techniques to the extent feasible in the development at this Site, on-Site buildings included, at a minimum, a 20-mil vapor barrier on the foundation to improve energy efficiency and meet Passive House standards. The buildings have been designed and constructed to meet Passive House standards. Once the project is completed, the Sendero Verde Redevelopment Project (both Parcels A [BCP Site No. C231135] and Parcel B [BCP Site No. C231128]) will be the largest multi-family Passive House development in the United States and will be certified by both the Passive House Institute and Enterprise Green Communities, ensuring superior levels of energy efficiency, indoor air quality, occupant comfort, and resiliency. Buildings meeting Passive House design standards can be up to 60 or 70 percent more energy efficient than a traditionally designed building of similar size.

Conservation and efficient management of resources and materials, along with reduction of waste and increase in recycling and reuse of materials which would otherwise be considered a waste, were two of the green remediation principles incorporated during the remedial action. To adhere to these principles the Volunteer exported approximately 111.25 tons of clean concrete and bricks to permitted Class B recycling facilities in New York and New Jersey for recycling.

6.3 Soil Vapor Intrusion Evaluation

An SVI evaluation must be performed upon a change in use of the property that will result in occupancy of a previously unoccupied building (excluding the buildings currently under construction at the time this SMP was issued) or initial occupancy of a new building (excluding the buildings currently under construction at the time this SMP was issued). This SVI evaluation has already been completed for the buildings currently under construction, as documented in the FER. The breadth of the SVI evaluation will be determined based upon discussion with the NYSDEC project manager and NYSDOH. Per this discussion and other agency requirements, a work plan may need to be developed that requires that sampling be performed. At a minimum, an SVI sampling work plan would include the following information:

- A figure showing the soil vapor intrusion sample locations;
- Discussion of the depths of the soil vapor samples; and
- A table of sample locations and analytical parameters to be analyzed along with the minimum reporting limits to be achieved by the NYS ELAP-certified laboratory.

If an action is required upon completion of the SVI evaluation, any actions taken or to be taken must be reflected in an updated SMP and submitted to the NYSDEC project manager for approval.

7.0 REPORTING REQUIREMENTS

7.1 Site Management Reports

All site management inspection and maintenance events will be recorded on the appropriate site management forms provided in Appendix G. These forms are subject to NYSDEC revision. All site management inspection and maintenance events will be conducted by a qualified environmental professional as defined in 6 NYCRR Part 375, a PE who is licensed and registered in New York State, or a qualified person who directly reports to a PE who is licensed and registered in New York state.

All applicable inspection forms and other records generated for the Site during the reporting period will be provided in electronic format to the NYSDEC in accordance with the requirements of Table 10 and summarized in the Periodic Review Report.

Table 10: Schedule of Interim Inspection Reports

Task/Report	Reporting Frequency*
Inspection Report	Annually or as otherwise determined by the Department
Periodic Review Report	Due 30 days after the end of each certification period. First report will be submitted after the first 16-month certification period, then annually until completion and documentation of all development-related construction, then every 3 years thereafter or as otherwise determined by the NYSDEC.
SVI Evaluation	Upon change of use/occupancy of a previously unoccupied building or initial occupancy of a new building (excluding the buildings currently under construction at the time this SMP was issued, as this evaluation has already been completed and is documented in the FER).

* The frequency of events will be conducted as specified until otherwise amended and approved by the NYSDEC.

All interim inspections reports will include, at a minimum:

- Date of event or reporting period;
- Name, company, and position of person(s) conducting inspection activities;

- Description of the activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet);
- Any observations, conclusions, or recommendations; and
- A determination as to whether contaminant conditions have changed since the last reporting event.

Routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting maintenance activities;
- Description of maintenance activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet); and
- Other documentation such as copies of invoices for maintenance work, receipts for replacement equipment, etc., (attached to the checklist/form).

Non-routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting non-routine maintenance/repair activities;
- Description of non-routine activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents (included either on the form or on an attached sheet); and
- Other documentation such as copies of invoices for repair work, receipts for replacement equipment, etc. (attached to the checklist/form).

If any data is generated, it will be reported in digital format as identified by the NYSDEC. Currently, data is to be supplied electronically and submitted to the NYSDEC EQuIS^{TM} database in accordance with the requirements found at this link http://www.dec.ny.gov/chemical/62440.html.

7.2 Periodic Review Report

A Periodic Review Report (PRR) will be submitted to the NYSDEC 30 days after the initial sixteen (16) month certification period. After submittal of the initial Periodic Review

Report, the subsequent PRRs shall be submitted annually to the NYSDEC project manager or at another frequency as may be required by the NYSDEC project manager. In the event that the Site is subdivided into separate parcels with different ownership, a single Periodic Review Report will be prepared that addresses the Site described in Appendix A - Environmental Easement. The Report will be prepared in accordance with NYSDEC's DER-10 and submitted within 30 days of the end of each certification period. Media sampling results (if any) will also be incorporated into the Periodic Review Report. The Report will include:

- Identification, assessment and certification of all EC/ICs required by the remedy for the Site.
- Results of the required annual Site inspections and severe condition inspections, if applicable.
- All applicable Site management forms and other records generated for the Site during the reporting period in the NYSDEC-approved electronic format, if not previously submitted.
- If any data is collected, data summary tables and graphical representations of contaminants of concern by media (soil vapor), which include a listing of all compounds analyzed, along with the applicable standards, with all exceedances highlighted. These will include a presentation of past data as part of an evaluation of contaminant concentration trends.
- If any data is collected, results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period will be submitted in digital format as identified by the NYSDEC. Currently, data is supplied electronically and submitted to the NYSDEC EQuIS™ database in accordance with the requirements found at this link: http://www.dec.ny.gov/chemical/62440.html.
- A Site evaluation, which includes the following:
    - The compliance of the remedy with the requirements of the Site-specific RAWP;
    - Any new conclusions or observations regarding Site contamination based on inspections or data (if any) generated by the Sampling Plan for the media being monitored;
    - Recommendations regarding any necessary changes to the remedy and/or Sampling Plan; and
    - The overall performance and effectiveness of the remedy.

7.2.1 Certification of Institutional and Engineering Controls

Following the last inspection of the reporting period, a Professional Engineer licensed to practice in New York State will prepare, and include in the Periodic Review Report, the following certification as per the requirements of NYSDEC DER-10:

"*For each institutional or engineering control identified for the Site, I certify that all of the following statements are true:*

- *The inspection of the Site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;*
- *The institutional control and/or engineering control employed at this Site is unchanged from the date the control was put in place, or last approved by the Department;*
- *Nothing has occurred that would impair the ability of the control to protect the public health and environment;*
- *Nothing has occurred that would constitute a violation or failure to comply with any Site management plan for this control;*
- *Access to the Site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;*
- *Use of the Site is compliant with the environmental easement;*
- *The engineering control systems are performing as designed and are effective;*
- *To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the Site remedial program and generally accepted engineering practices; and*
- *The information presented in this report is accurate and complete.*

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, Noelle Clarke, of Roux Environmental Engineering and Geology, D.P.C., am certifying as Owner's Designated Site Representative.

- *No new information has come to my attention, including groundwater monitoring data from wells located at the Site boundary, if any, to indicate that the assumptions made in the qualitative exposure assessment of off-Site contamination are no longer valid; and*

For BCP projects, every five years the following certification will be added:

- *The assumptions made in the qualitative exposure assessment remain valid.*

The signed certification will be included in the Periodic Review Report.

The Periodic Review Report will be submitted, in an approved electronic format, to the NYSDEC project manager and the NYSDOH project manager. The Periodic Review Report may need to be submitted in hard-copy format, as requested by the NYSDEC project manager.

7.3 Corrective Measures Work Plan

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an IC or EC, a Corrective Measures Work Plan will be submitted to the NYSDEC project manager for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the Corrective Measures Work Plan until it has been approved by the NYSDEC project manager.

8.0 REFERENCES

6NYCRR Part 375, Environmental Remediation Programs. December 14, 2006.

Amendment to the Phase II ESA, prepared by Roux Environmental Engineering and Geology, D.P.C., dated November 13, 2018.

NYSDEC DER-10 – “Technical Guidance for Site Investigation and Remediation”.

NYSDEC, 1998. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1. June 1998 (April 2000 addendum).

Phase I Environmental Site Assessment (ESA), prepared by Roux Environmental Engineering and Geology, D.P.C., dated March 30, 2018.

Phase II ESA, prepared by Roux Environmental Engineering and Geology, D.P.C., dated June 8, 2018.

Remedial Investigation Report (RIR)/Remedial Action Work Plan (RAWP), prepared by Roux Environmental Engineering and Geology, D.P.C., dated May 2021.

Waste Characterization Soil Sampling Letter Report, prepared by Roux Environmental Engineering and Geology, D.P.C., dated February 18, 2019.

TABLES

Table 2. Summary of Groundwater Elevation Data, Sendero Verde Redevelopment Project- Parcel A, New York, NY

Monitoring Well Identification	Date	Measuring Point Elevation (ft. NAVD 88)	Depth to Water (ft-btoc)	Water Table Elevation (ft. NAVD 88)
SVA-/MW-1	12/3/2020	16.41	12.00	4.41
SVA-/MW-2	12/3/2020	17.22	12.35	4.87
SVA-/MW-3	12/3/2020	16.71	12.26	4.45
SVA-/MW-4	11/20/2020	18.48	13.60	4.88

Notes:
ft= feet
NAVD 88= North American Vertical Datum of 1988
btoc= below top of casing

Notes Utilized Throughout Tables

Soil Tables

J - Estimated value
U - Indicates that the compound was analyzed for but not detected
B - The analyte was found in an associated blank as well as in the sample
R - Sample results rejected by validator
UJ - Analyte was not detected. The associated reported quantitation limit is an estimate
J- - Estimated value, low bias
P - The RPD between the results for the two columns exceeds the method-specified criteria
I - The lower value for the two columns has been reported due to obvious interference
RPD - Relative Percent Difference
ft bls - Feet below land surface
FD - Duplicate sample
NA - Compound was not analyzed for by laboratory
µg/kg - Micrograms per kilogram, equivalent to nanograms per gram
mg/kg - Milligrams per kilogram
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 Residential SCO

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

Per- and Polyfluoroalkyl Substances

GV - Guidance Values

Bold data indicates that parameter exceeded the NYSDEC Unrestricted Use Guidance Values

Shaded data indicates that parameter exceeded the NYSDEC Residential Guidance Values

Red data indicates that parameter exceeded the NYSDEC Restricted Residential Guidance Values

Table 3. Summary of Volatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas (None Present)
50 East 112th Street, New York, New York

Sample Designation:
Sample Date:
Normal Sample or Field Duplicate:
Sample Depth (ft bls):

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units
1,1,1,2-Tetrachloroethane	--	--	--	MG/KG
1,1,1-Trichloroethane (TCA)	0.68	100	100	MG/KG
1,1,2,2-Tetrachloroethane	--	--	--	MG/KG
1,1,2-Trichloroethane	--	--	--	MG/KG
1,1-Dichloroethane	0.27	19	26	MG/KG
1,1-Dichloroethene	0.33	100	100	MG/KG
1,1-Dichloropropene	--	--	--	MG/KG
1,2,3-Trichlorobenzene	--	--	--	MG/KG
1,2,3-Trichloropropane	--	--	--	MG/KG
1,2,4,5-Tetramethylbenzene	--	--	--	MG/KG
1,2,4-Trichlorobenzene	--	--	--	MG/KG
1,2,4-Trimethylbenzene	3.6	47	52	MG/KG
1,2-Dibromo-3-Chloropropane	--	--	--	MG/KG
1,2-Dibromoethane (Ethylene Dibromide)	--	--	--	MG/KG
1,2-Dichlorobenzene	1.1	100	100	MG/KG
1,2-Dichloroethane	0.02	2.3	3.1	MG/KG
1,2-Dichloropropane	--	--	--	MG/KG
1,3,5-Trimethylbenzene (Mesitylene)	8.4	47	52	MG/KG
1,3-Dichlorobenzene	2.4	17	49	MG/KG
1,3-Dichloropropane	--	--	--	MG/KG
1,4-Dichlorobenzene	1.8	9.8	13	MG/KG
1,4-Diethyl Benzene	--	--	--	MG/KG
1,4-Dioxane (P-Dioxane)	0.1	9.8	13	MG/KG
2,2-Dichloropropane	--	--	--	MG/KG
2-Chlorotoluene	--	--	--	MG/KG
2-Hexanone	--	--	--	MG/KG
4-Chlorotoluene	--	--	--	MG/KG
4-Ethyltoluene	--	--	--	MG/KG
Acetone	0.05	100	100	MG/KG
Acrylonitrile	--	--	--	MG/KG
Benzene	0.06	2.9	4.8	MG/KG
Bromobenzene	--	--	--	MG/KG

Table 3. Summary of Volatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas (None Present)
50 East 112th Street, New York, New York

				Sample Designation:
				Sample Date:
				Normal Sample or Field Duplicate:
				Sample Depth (ft bls):
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units
Bromochloromethane	--	--	--	MG/KG
Bromodichloromethane	--	--	--	MG/KG
Bromoform	--	--	--	MG/KG
Bromomethane	--	--	--	MG/KG
Carbon Disulfide	--	--	--	MG/KG
Carbon Tetrachloride	0.76	1.4	2.4	MG/KG
Chlorobenzene	1.1	100	100	MG/KG
Chloroethane	--	--	--	MG/KG
Chloroform	0.37	10	49	MG/KG
Chloromethane	--	--	--	MG/KG
Cis-1,2-Dichloroethylene	0.25	59	100	MG/KG
Cis-1,3-Dichloropropene	--	--	--	MG/KG
Cymene	--	--	--	MG/KG
Dibromochloromethane	--	--	--	MG/KG
Dibromomethane	--	--	--	MG/KG
Dichlorodifluoromethane	--	--	--	MG/KG
Dichloroethylenes	--	--	--	MG/KG
Diethyl Ether (Ethyl Ether)	--	--	--	MG/KG
Ethylbenzene	1	30	41	MG/KG
Hexachlorobutadiene	--	--	--	MG/KG
Isopropylbenzene (Cumene)	--	--	--	MG/KG
m,p-Xylene	--	--	--	MG/KG
Methyl Ethyl Ketone (2-Butanone)	0.12	100	100	MG/KG
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	--	--	--	MG/KG
Methylene Chloride	0.05	51	100	MG/KG
Naphthalene	12	100	100	MG/KG
N-Butylbenzene	12	100	100	MG/KG
N-Propylbenzene	3.9	100	100	MG/KG
O-Xylene (1,2-Dimethylbenzene)	--	--	--	MG/KG
Sec-Butylbenzene	11	100	100	MG/KG
Styrene	--	--	--	MG/KG
T-Butylbenzene	5.9	100	100	MG/KG

Table 3. Summary of Volatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas (None Present)
50 East 112th Street, New York, New York

Sample Designation:
Sample Date:
Normal Sample or Field Duplicate:
Sample Depth (ft bls):

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units
Tert-Butyl Methyl Ether	0.93	62	100	MG/KG
Tetrachloroethylene (PCE)	1.3	5.5	19	MG/KG
Toluene	0.7	100	100	MG/KG
Total, 1,3-Dichloropropene (Cis And Trans)	--	--	--	MG/KG
Trans-1,2-Dichloroethene	0.19	100	100	MG/KG
Trans-1,3-Dichloropropene	--	--	--	MG/KG
Trans-1,4-Dichloro-2-Butene	--	--	--	MG/KG
Trichloroethylene (TCE)	0.47	10	21	MG/KG
Trichlorofluoromethane	--	--	--	MG/KG
Vinyl Acetate	--	--	--	MG/KG
Vinyl Chloride	0.02	0.21	0.9	MG/KG
Xylenes	0.26	100	100	MG/KG

Table 4. Summary of Semivolatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

					Sample Designation:	SVA-SB-1	SVA-SB-1	SVA-SB-7
					Sample Date:	11/19/2020	11/23/2020	11/19/2020
					Normal Sample or Field Duplicate:	N	N	N
					Sample Depth (ft bls):	2 - 4	15 - 17	2 - 4
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	Analytical Method			
1,2,4,5-Tetrachlorobenzene	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
1,2,4-Trichlorobenzene	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
1,2-Dichlorobenzene	1.1	100	100	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
1,3-Dichlorobenzene	2.4	17	49	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
1,4-Dichlorobenzene	1.8	9.8	13	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
1,4-Dioxane (P-Dioxane)	0.1	9.8	13	MG/KG	SW8270D	0.029 U	0.029 U	0.029 U
1,4-Dioxane (P-Dioxane)	0.1	9.8	13	MG/KG	SW8270DSIM	NA	NA	NA
2,4,5-Trichlorophenol	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2,4,6-Trichlorophenol	--	--	--	MG/KG	SW8270D	0.12 U	0.12 U	0.12 U
2,4-Dichlorophenol	--	--	--	MG/KG	SW8270D	0.18 U	0.18 U	0.18 U
2,4-Dimethylphenol	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2,4-Dinitrophenol	--	--	--	MG/KG	SW8270D	0.94 U	0.93 U	0.94 U
2,4-Dinitrotoluene	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2,6-Dinitrotoluene	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2-Chloronaphthalene	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2-Chlorophenol	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2-Methylnaphthalene	--	--	--	MG/KG	SW8270D	0.06 J	0.14 J	0.13 J
2-Methylphenol (O-Cresol)	0.33	100	100	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2-Nitroaniline	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
2-Nitrophenol	--	--	--	MG/KG	SW8270D	0.42 U	0.42 U	0.42 U
3,3'-Dichlorobenzidine	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
3-Nitroaniline	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
4,6-Dinitro-2-Methylphenol	--	--	--	MG/KG	SW8270D	0.51 U	0.51 U	0.51 U
4-Bromophenyl Phenyl Ether	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
4-Chloro-3-Methylphenol	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
4-Chloroaniline	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
4-Chlorophenyl Phenyl Ether	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
4-Nitroaniline	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
4-Nitrophenol	--	--	--	MG/KG	SW8270D	0.27 U	0.27 U	0.27 U
Acenaphthene	20	100	100	MG/KG	SW8270D	0.1 J	0.082 J	0.096 J

Table 4. Summary of Semivolatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

					Sample Designation:	**SVA-SB-1**	**SVA-SB-1**	**SVA-SB-7**
					Sample Date:	**11/19/2020**	**11/23/2020**	**11/19/2020**
					Normal Sample or Field Duplicate:	**N**	**N**	**N**
					Sample Depth (ft bls):	**2 - 4**	**15 - 17**	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	Analytical Method			
Acenaphthylene	100	100	100	MG/KG	SW8270D	0.98	1.5	1.9
Acetophenone	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
Anthracene	100	100	100	MG/KG	SW8270D	0.74	0.69	1.3
Benzo(A)Anthracene	1	1	1	MG/KG	SW8270D	**2.1**	**1.2**	**3.6**
Benzo(A)Pyrene	1	1	1	MG/KG	SW8270D	**2.6**	**1.2**	**4.3**
Benzo(B)Fluoranthene	1	1	1	MG/KG	SW8270D	**3.8**	**1.4**	**5.7**
Benzo(G,H,I)Perylene	100	100	100	MG/KG	SW8270D	1.9	0.94	3.1
Benzo(K)Fluoranthene	0.8	1	3.9	MG/KG	SW8270D	**1.2**	0.31	**1.9**
Benzoic Acid	--	--	--	MG/KG	SW8270D	0.26 J	0.63 U	0.22 J
Benzyl Alcohol	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
Benzyl Butyl Phthalate	--	--	--	MG/KG	SW8270D	0.32	0.19 U	0.14 J
Biphenyl (Diphenyl)	--	--	--	MG/KG	SW8270D	0.45 U	0.44 U	0.046 J
Bis(2-Chloroethoxy) Methane	--	--	--	MG/KG	SW8270D	0.21 U	0.21 U	0.21 U
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	--	--	--	MG/KG	SW8270D	0.18 U	0.18 U	0.18 U
Bis(2-Chloroisopropyl) Ether	--	--	--	MG/KG	SW8270D	0.24 U	0.23 U	0.24 U
Bis(2-Ethylhexyl) Phthalate	--	--	--	MG/KG	SW8270D	5.7	0.19 U	6.4 J
Carbazole	--	--	--	MG/KG	SW8270D	0.47	0.078 J	0.5
Chrysene	1	1	3.9	MG/KG	SW8270D	**2.8**	**1.3**	**3.9**
Dibenz(A,H)Anthracene	0.33	0.33	0.33	MG/KG	SW8270D	**0.51**	0.22	**0.75**
Dibenzofuran	7	14	59	MG/KG	SW8270D	0.13 J	0.051 J	0.26
Diethyl Phthalate	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
Dimethyl Phthalate	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
Di-N-Butyl Phthalate	--	--	--	MG/KG	SW8270D	0.044 J	0.19 U	0.2 U
Di-N-Octylphthalate	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
Fluoranthene	100	100	100	MG/KG	SW8270D	5.2	1.7	7.6
Fluorene	30	100	100	MG/KG	SW8270D	0.18 J	0.21	0.25
Hexachlorobenzene	0.33	0.33	1.2	MG/KG	SW8270D	0.12 U	0.12 U	0.12 U
Hexachlorobutadiene	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
Hexachlorocyclopentadiene	--	--	--	MG/KG	SW8270D	0.56 U	0.56 U	0.56 U
Hexachloroethane	--	--	--	MG/KG	SW8270D	0.16 U	0.16 U	0.16 U

Table 4. Summary of Semivolatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

					Sample Designation:	**SVA-SB-1**	**SVA-SB-1**	**SVA-SB-7**
					Sample Date:	**11/19/2020**	**11/23/2020**	**11/19/2020**
					Normal Sample or Field Duplicate:	**N**	**N**	**N**
					Sample Depth (ft bls):	**2 - 4**	**15 - 17**	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	Analytical Method			
Indeno(1,2,3-C,D)Pyrene	0.5	0.5	0.5	MG/KG	SW8270D	**2**	**0.76**	**3**
Isophorone	--	--	--	MG/KG	SW8270D	0.18 U	0.18 U	0.18 U
M+P MethylPhenol	0.33	34	100	MG/KG	SW8270D	0.063 J	0.28 U	0.093 J
Naphthalene	12	100	100	MG/KG	SW8270D	0.13 J	0.22	0.48
Nitrobenzene	--	--	--	MG/KG	SW8270D	0.18 U	0.18 U	0.18 U
N-Nitrosodi-N-Propylamine	--	--	--	MG/KG	SW8270D	0.2 U	0.19 U	0.2 U
N-Nitrosodiphenylamine	--	--	--	MG/KG	SW8270D	0.16 U	0.16 U	0.16 U
Pentachlorophenol	0.8	2.4	6.7	MG/KG	SW8270D	0.16 U	0.16 U	0.16 U
Phenanthrene	100	100	100	MG/KG	SW8270D	2.9	1.1	4.3
Phenol	0.33	100	100	MG/KG	SW8270D	0.033 J	0.19 U	0.066 J
Pyrene	100	100	100	MG/KG	SW8270D	4.3	2.3	6.4

Table 4. Summary of Semivolatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

					Sample Designation:	**SVA-SB-7**
					Sample Date:	**11/19/2020**
					Normal Sample or Field Duplicate:	**FD**
					Sample Depth (ft bls):	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	Analytical Method	
1,2,4,5-Tetrachlorobenzene	--	--	--	MG/KG	SW8270D	0.39 U
1,2,4-Trichlorobenzene	--	--	--	MG/KG	SW8270D	0.39 U
1,2-Dichlorobenzene	1.1	100	100	MG/KG	SW8270D	0.39 U
1,3-Dichlorobenzene	2.4	17	49	MG/KG	SW8270D	0.39 U
1,4-Dichlorobenzene	1.8	9.8	13	MG/KG	SW8270D	0.39 U
1,4-Dioxane (P-Dioxane)	0.1	9.8	13	MG/KG	SW8270D	0.059 U
1,4-Dioxane (P-Dioxane)	0.1	9.8	13	MG/KG	SW8270DSIM	NA
2,4,5-Trichlorophenol	--	--	--	MG/KG	SW8270D	0.39 U
2,4,6-Trichlorophenol	--	--	--	MG/KG	SW8270D	0.24 U
2,4-Dichlorophenol	--	--	--	MG/KG	SW8270D	0.35 U
2,4-Dimethylphenol	--	--	--	MG/KG	SW8270D	0.39 U
2,4-Dinitrophenol	--	--	--	MG/KG	SW8270D	1.9 U
2,4-Dinitrotoluene	--	--	--	MG/KG	SW8270D	0.39 U
2,6-Dinitrotoluene	--	--	--	MG/KG	SW8270D	0.39 U
2-Chloronaphthalene	--	--	--	MG/KG	SW8270D	0.39 U
2-Chlorophenol	--	--	--	MG/KG	SW8270D	0.39 U
2-Methylnaphthalene	--	--	--	MG/KG	SW8270D	0.14 J
2-Methylphenol (O-Cresol)	0.33	100	100	MG/KG	SW8270D	0.39 U
2-Nitroaniline	--	--	--	MG/KG	SW8270D	0.39 U
2-Nitrophenol	--	--	--	MG/KG	SW8270D	0.85 U
3,3'-Dichlorobenzidine	--	--	--	MG/KG	SW8270D	0.39 U
3-Nitroaniline	--	--	--	MG/KG	SW8270D	0.39 U
4,6-Dinitro-2-Methylphenol	--	--	--	MG/KG	SW8270D	1 U
4-Bromophenyl Phenyl Ether	--	--	--	MG/KG	SW8270D	0.39 U
4-Chloro-3-Methylphenol	--	--	--	MG/KG	SW8270D	0.39 U
4-Chloroaniline	--	--	--	MG/KG	SW8270D	0.39 U
4-Chlorophenyl Phenyl Ether	--	--	--	MG/KG	SW8270D	0.39 U
4-Nitroaniline	--	--	--	MG/KG	SW8270D	0.39 U
4-Nitrophenol	--	--	--	MG/KG	SW8270D	0.55 U
Acenaphthene	20	100	100	MG/KG	SW8270D	0.083 J

Table 4. Summary of Semivolatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

					Sample Designation:	**SVA-SB-7**
					Sample Date:	**11/19/2020**
					Normal Sample or Field Duplicate:	**FD**
					Sample Depth (ft bls):	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	Analytical Method	
Acenaphthylene	100	100	100	MG/KG	SW8270D	2.1
Acetophenone	--	--	--	MG/KG	SW8270D	0.39 U
Anthracene	100	100	100	MG/KG	SW8270D	1.2
Benzo(A)Anthracene	1	1	1	MG/KG	SW8270D	**5**
Benzo(A)Pyrene	1	1	1	MG/KG	SW8270D	**5.3**
Benzo(B)Fluoranthene	1	1	1	MG/KG	SW8270D	**7.4**
Benzo(G,H,I)Perylene	100	100	100	MG/KG	SW8270D	4.5
Benzo(K)Fluoranthene	0.8	1	3.9	MG/KG	SW8270D	**1.8**
Benzoic Acid	--	--	--	MG/KG	SW8270D	1.3 U
Benzyl Alcohol	--	--	--	MG/KG	SW8270D	0.39 U
Benzyl Butyl Phthalate	--	--	--	MG/KG	SW8270D	0.39 U
Biphenyl (Diphenyl)	--	--	--	MG/KG	SW8270D	0.9 U
Bis(2-Chloroethoxy) Methane	--	--	--	MG/KG	SW8270D	0.42 U
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	--	--	--	MG/KG	SW8270D	0.35 U
Bis(2-Chloroisopropyl) Ether	--	--	--	MG/KG	SW8270D	0.47 U
Bis(2-Ethylhexyl) Phthalate	--	--	--	MG/KG	SW8270D	0.56 J
Carbazole	--	--	--	MG/KG	SW8270D	0.65
Chrysene	1	1	3.9	MG/KG	SW8270D	**4.9**
Dibenz(A,H)Anthracene	0.33	0.33	0.33	MG/KG	SW8270D	**0.99**
Dibenzofuran	7	14	59	MG/KG	SW8270D	0.2 J
Diethyl Phthalate	--	--	--	MG/KG	SW8270D	0.39 U
Dimethyl Phthalate	--	--	--	MG/KG	SW8270D	0.39 U
Di-N-Butyl Phthalate	--	--	--	MG/KG	SW8270D	0.39 U
Di-N-Octylphthalate	--	--	--	MG/KG	SW8270D	0.39 U
Fluoranthene	100	100	100	MG/KG	SW8270D	8.1
Fluorene	30	100	100	MG/KG	SW8270D	0.14 J
Hexachlorobenzene	0.33	0.33	1.2	MG/KG	SW8270D	0.24 U
Hexachlorobutadiene	--	--	--	MG/KG	SW8270D	0.39 U
Hexachlorocyclopentadiene	--	--	--	MG/KG	SW8270D	1.1 U
Hexachloroethane	--	--	--	MG/KG	SW8270D	0.32 U

Table 4. Summary of Semivolatile Organic Compound Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

					Sample Designation:	**SVA-SB-7**
					Sample Date:	**11/19/2020**
					Normal Sample or Field Duplicate:	**FD**
					Sample Depth (ft bls):	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	Analytical Method	
Indeno(1,2,3-C,D)Pyrene	0.5	0.5	0.5	MG/KG	SW8270D	**4.4**
Isophorone	--	--	--	MG/KG	SW8270D	0.35 U
M+P MethylPhenol	0.33	34	100	MG/KG	SW8270D	0.15 J
Naphthalene	12	100	100	MG/KG	SW8270D	0.67
Nitrobenzene	--	--	--	MG/KG	SW8270D	0.35 U
N-Nitrosodi-N-Propylamine	--	--	--	MG/KG	SW8270D	0.39 U
N-Nitrosodiphenylamine	--	--	--	MG/KG	SW8270D	0.32 U
Pentachlorophenol	0.8	2.4	6.7	MG/KG	SW8270D	0.32 U
Phenanthrene	100	100	100	MG/KG	SW8270D	3.8
Phenol	0.33	100	100	MG/KG	SW8270D	0.077 J
Pyrene	100	100	100	MG/KG	SW8270D	7.5

Table 5. Summary of Metal Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

				Sample Designation:	**SVA-SB-1**	**SVA-SB-4**	**SVA-SB-7**	**SVA-SB-7**
				Sample Date:	**11/19/2020**	**11/20/2020**	**11/19/2020**	**11/19/2020**
				Normal Sample or Field Duplicate:	**N**	**N**	**N**	**FD**
				Sample Depth (ft bls):	**2 - 4**	**18 - 20**	**2 - 4**	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units				
Aluminum	--	--	--	MG/KG	4290	5800	5030	4320
Antimony	--	--	--	MG/KG	1.39 JB	27.7	2.31 JB	1.26 JB
Arsenic	13	16	16	MG/KG	6.91	4.52	9.44	6.84
Barium	350	350	400	MG/KG	**691**	**465**	**622**	**652**
Beryllium	7.2	14	72	MG/KG	0.047 J	0.444 U	0.455 U	0.467 U
Cadmium	2.5	2.5	4.3	MG/KG	1.56	1.61	**2.64 J**	1.01 J
Calcium	--	--	--	MG/KG	53700	30300	64400	65600
Chromium III	30	36	180	MG/KG	19	18	20	14
Chromium, Hexavalent	1	22	110	MG/KG	0.967 U	0.92 U	0.964 U	0.957 U
Chromium, Total	30	36	180	MG/KG	19	17.7	20.5	14
Cobalt	--	--	--	MG/KG	4.55	6.22	7.62	4.67
Copper	50	270	270	MG/KG	23.8	42.5	29.2	24
Cyanide	27	27	27	MG/KG	0.71 J	1.1 UJ	0.28 J	0.52 J
Iron	--	--	--	MG/KG	12000	16000	42700 J	10800 J
Lead	63	400	400	MG/KG	**473**	**942**	**265**	**261**
Magnesium	--	--	--	MG/KG	3520	4170	5490	4450
Manganese	1600	2000	2000	MG/KG	265	321	618	372
Mercury	0.18	0.81	0.81	MG/KG	**0.393**	**5.35**	**0.307**	**0.379**
Nickel	30	140	310	MG/KG	13.2	11.8	15.9	10.4
Potassium	--	--	--	MG/KG	745	2750	875	739
Selenium	3.9	36	180	MG/KG	0.495 J	0.844 J	0.236 J	0.43 J
Silver	2	36	180	MG/KG	0.934 U	**4.12**	0.273 J	0.934 U
Sodium	--	--	--	MG/KG	394	283	384	284
Thallium	--	--	--	MG/KG	1.87 U	1.78 U	1.82 U	1.87 U
Vanadium	--	--	--	MG/KG	19.6	23.5	21.4	21.4
Zinc	109	2200	10000	MG/KG	**991**	**455**	**869**	**567**

Table 6. Summary of Polychlorinated Biphenyl Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

				Sample Designation:	**SVA-SB-7**
				Sample Date:	**11/19/2020**
				Normal Sample or Field Duplicate:	**N**
				Sample Depth (ft bls):	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	
PCB-1016 (Aroclor 1016)	--	--	--	MG/KG	0.0399 U
PCB-1221 (Aroclor 1221)	--	--	--	MG/KG	0.0399 U
PCB-1232 (Aroclor 1232)	--	--	--	MG/KG	0.0399 U
PCB-1242 (Aroclor 1242)	--	--	--	MG/KG	0.0399 U
PCB-1248 (Aroclor 1248)	--	--	--	MG/KG	0.0399 U
PCB-1254 (Aroclor 1254)	--	--	--	MG/KG	0.063
PCB-1260 (Aroclor 1260)	--	--	--	MG/KG	0.027 J
PCB-1262 (Aroclor 1262)	--	--	--	MG/KG	0.0399 U
PCB-1268 (Aroclor 1268)	--	--	--	MG/KG	0.0188 J
Polychlorinated Biphenyl (PCBs)	0.1	1	1	MG/KG	**0.109 J**

Table 7. Summary of Pesticide and Herbicide Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

Sample Designation:					**BCS-2**	**SDS-2**	**SVA-SB-1**
Sample Date:					**02/11/2022**	**12/13/2021**	**11/19/2020**
Normal Sample or Field Duplicate:					**N**	**N**	**N**
Sample Depth (ft bls):					**15 - 17**	**10 - 10**	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units			
2,4-(Dichlorophenoxy)butyric acid	--	--	--	MG/KG	0.2 U	NA	NA
2,4-D (Dichlorophenoxyacetic Acid)	--	--	--	MG/KG	0.2 U	0.19 U	0.199 U
Acetic acid, (2,4,5-trichlorophenoxy)-	--	--	--	MG/KG	0.2 U	0.19 U	0.199 U
Aldrin	0.005	0.019	0.097	MG/KG	0.00189 U	0.00172 U	0.00131 J
Alpha Bhc (Alpha Hexachlorocyclohexane)	0.02	0.097	0.48	MG/KG	0.000786 U	0.000719 U	0.000782 U
Alpha Endosulfan	2.4	4.8	24	MG/KG	0.00189 U	0.00172 U	0.00188 U
Beta Bhc (Beta Hexachlorocyclohexane)	0.036	0.072	0.36	MG/KG	0.00189 U	0.00172 U	0.00188 U
Beta Endosulfan	2.4	4.8	24	MG/KG	0.00189 U	0.00172 U	0.00188 U
Chlordane	--	--	--	MG/KG	0.0157 U	0.0582 J	0.245
cis-Chlordane	0.094	0.91	4.2	MG/KG	0.00168 J	0.00788	0.0582
Dalapon	--	--	--	MG/KG	0.0401 U	NA	NA
Delta BHC (Delta Hexachlorocyclohexane)	0.04	100	100	MG/KG	0.00189 U	0.00172 U	0.00248
Dicamba	--	--	--	MG/KG	0.0401 U	NA	NA
Dichloroprop	--	--	--	MG/KG	0.0401 U	NA	NA
Dieldrin	0.005	0.039	0.2	MG/KG	0.00168	**0.00842**	**0.0982**
Endosulfan Sulfate	2.4	4.8	24	MG/KG	0.000786 U	0.000719 U	0.000782 U
Endrin	0.014	2.2	11	MG/KG	0.000786 U	0.000719 U	0.000782 U
Endrin Aldehyde	--	--	--	MG/KG	0.00236 U	0.00216 U	0.00234 U
Endrin Ketone	--	--	--	MG/KG	0.00189 U	0.00172 U	0.00188 U
Gamma Bhc (Lindane)	0.1	0.28	1.3	MG/KG	0.000786 U	0.000719 U	0.000782 U
Heptachlor	0.042	0.42	2.1	MG/KG	0.000943 U	0.000862 U	0.00283 J
Heptachlor Epoxide	--	--	--	MG/KG	0.00354 U	0.00323 U	0.00347 J
MCPA	--	--	--	MG/KG	4.01 U	NA	NA
Methoxychlor	--	--	--	MG/KG	0.00354 U	0.00323 U	0.00352 U
P,P'-DDD	0.0033	2.6	13	MG/KG	0.00189 U	**0.00529 J**	**0.0209**
P,P'-DDE	0.0033	1.8	8.9	MG/KG	**0.00345**	**0.015**	**0.107**
P,P'-DDT	0.0033	1.7	7.9	MG/KG	**0.0102 J**	**0.0493**	**0.555**
Silvex (2,4,5-TP)	3.8	58	100	MG/KG	0.2 U	0.19 U	0.199 U
Toxaphene	--	--	--	MG/KG	0.0354 U	0.0323 U	0.0352 U
trans-Chlordane	--	--	--	MG/KG	0.00234 J	0.00758	0.0428

Table 7. Summary of Pesticide and Herbicide Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

				Sample Designation:	SVA-SB-4	SVA-SB-4	SVA-SB-7
				Sample Date:	11/20/2020	11/20/2020	11/19/2020
				Normal Sample or Field Duplicate:	N	N	N
				Sample Depth (ft bls):	18 - 20	20 - 22	2 - 4
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units			
2,4-(Dichlorophenoxy)butyric acid	--	--	--	MG/KG	NA	NA	NA
2,4-D (Dichlorophenoxyacetic Acid)	--	--	--	MG/KG	0.19 U	NA	0.198 U
Acetic acid, (2,4,5-trichlorophenoxy)-	--	--	--	MG/KG	0.19 U	NA	0.198 U
Aldrin	0.005	0.019	0.097	MG/KG	0.0018 U	0.00175 U	0.000886 J
Alpha Bhc (Alpha Hexachlorocyclohexane)	0.02	0.097	0.48	MG/KG	0.000749 U	0.00073 U	0.000764 U
Alpha Endosulfan	2.4	4.8	24	MG/KG	0.0018 U	0.00175 U	0.00183 U
Beta Bhc (Beta Hexachlorocyclohexane)	0.036	0.072	0.36	MG/KG	0.0018 U	0.00175 U	0.00183 U
Beta Endosulfan	2.4	4.8	24	MG/KG	0.0018 U	0.00175 U	0.00183 U
Chlordane	--	--	--	MG/KG	0.015 U	0.0146 U	0.423
cis-Chlordane	0.094	0.91	4.2	MG/KG	0.0105	0.0152 J	**0.111**
Dalapon	--	--	--	MG/KG	NA	NA	NA
Delta BHC (Delta Hexachlorocyclohexane)	0.04	100	100	MG/KG	0.0018 U	0.00175 U	0.00187
Dicamba	--	--	--	MG/KG	NA	NA	NA
Dichloroprop	--	--	--	MG/KG	NA	NA	NA
Dieldrin	0.005	0.039	0.2	MG/KG	**0.00737**	**0.0226**	**0.0544**
Endosulfan Sulfate	2.4	4.8	24	MG/KG	0.000749 U	0.00073 U	0.000764 U
Endrin	0.014	2.2	11	MG/KG	0.000749 U	0.00073 U	0.000764 U
Endrin Aldehyde	--	--	--	MG/KG	0.00225 U	0.00219 U	0.00229 U
Endrin Ketone	--	--	--	MG/KG	0.0018 U	0.00175 U	0.00183 U
Gamma Bhc (Lindane)	0.1	0.28	1.3	MG/KG	0.000749 U	0.00073 U	0.000764 U
Heptachlor	0.042	0.42	2.1	MG/KG	0.000899 U	0.000876 U	0.00277
Heptachlor Epoxide	--	--	--	MG/KG	0.00337 U	0.00256 J	0.00365 J
MCPA	--	--	--	MG/KG	NA	NA	NA
Methoxychlor	--	--	--	MG/KG	0.00337 U	0.00328 U	0.00344 U
P,P'-DDD	0.0033	2.6	13	MG/KG	**0.00498**	**0.00672**	**0.0392**
P,P'-DDE	0.0033	1.8	8.9	MG/KG	**0.026**	**0.0782**	**0.0551**
P,P'-DDT	0.0033	1.7	7.9	MG/KG	**0.0954**	**0.242**	**0.285**
Silvex (2,4,5-TP)	3.8	58	100	MG/KG	0.19 U	NA	0.198 U
Toxaphene	--	--	--	MG/KG	0.0337 U	0.0328 U	0.0344 U
trans-Chlordane	--	--	--	MG/KG	0.00496 J	0.0159	0.0808

Table 7. Summary of Pesticide and Herbicide Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

Sample Designation:					**SVA-SB-7**
Sample Date:					**11/19/2020**
Normal Sample or Field Duplicate:					**FD**
Sample Depth (ft bls):					**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Residential SCO	NYSDEC Part 375 Restricted Residential SCO	Units	
2,4-(Dichlorophenoxy)butyric acid	--	--	--	MG/KG	NA
2,4-D (Dichlorophenoxyacetic Acid)	--	--	--	MG/KG	0.196 U
Acetic acid, (2,4,5-trichlorophenoxy)-	--	--	--	MG/KG	0.196 U
Aldrin	0.005	0.019	0.097	MG/KG	0.00071 J
Alpha Bhc (Alpha Hexachlorocyclohexane)	0.02	0.097	0.48	MG/KG	0.000764 U
Alpha Endosulfan	2.4	4.8	24	MG/KG	0.00183 U
Beta Bhc (Beta Hexachlorocyclohexane)	0.036	0.072	0.36	MG/KG	0.00183 U
Beta Endosulfan	2.4	4.8	24	MG/KG	0.00183 U
Chlordane	--	--	--	MG/KG	0.464
cis-Chlordane	0.094	0.91	4.2	MG/KG	0.0708 J
Dalapon	--	--	--	MG/KG	NA
Delta BHC (Delta Hexachlorocyclohexane)	0.04	100	100	MG/KG	0.00233
Dicamba	--	--	--	MG/KG	NA
Dichloroprop	--	--	--	MG/KG	NA
Dieldrin	0.005	0.039	0.2	MG/KG	**0.0771**
Endosulfan Sulfate	2.4	4.8	24	MG/KG	0.000764 U
Endrin	0.014	2.2	11	MG/KG	0.000764 U
Endrin Aldehyde	--	--	--	MG/KG	0.00229 U
Endrin Ketone	--	--	--	MG/KG	0.00183 U
Gamma Bhc (Lindane)	0.1	0.28	1.3	MG/KG	0.000764 U
Heptachlor	0.042	0.42	2.1	MG/KG	0.00358
Heptachlor Epoxide	--	--	--	MG/KG	0.00344 U
MCPA	--	--	--	MG/KG	NA
Methoxychlor	--	--	--	MG/KG	0.00344 U
P,P'-DDD	0.0033	2.6	13	MG/KG	**0.0231**
P,P'-DDE	0.0033	1.8	8.9	MG/KG	**0.0455**
P,P'-DDT	0.0033	1.7	7.9	MG/KG	**0.354**
Silvex (2,4,5-TP)	3.8	58	100	MG/KG	0.196 U
Toxaphene	--	--	--	MG/KG	0.0344 U
trans-Chlordane	--	--	--	MG/KG	0.102

Table 8. Summary of Per- and Polyfluoroalkyl Substance Exceedances in Documentation Soil Samples in Track 2 and 4 Areas
50 East 112th Street, New York, New York

				Sample Designation:	**SDS-2**	**SVA-SB-1**	**SVA-SB-7**	**SVA-SB-7**
				Sample Date:	**12/13/2021**	**11/19/2020**	**11/19/2020**	**11/19/2020**
				Normal Sample or Field Duplicate:	**N**	**N**	**N**	**FD**
				Sample Depth (ft bls):	**10 - 10**	**2 - 4**	**2 - 4**	**2 - 4**
Parameter	NYSDEC Part 375 Unrestricted Use GV	NYSDEC Part 375 Residential GV	NYSDEC Part 375 Restricted Residential GV	Units				
2-(N-methyl perfluorooctanesulfonamido) acetic acid	--	--	--	UG/KG	0.254 U	0.572 U	0.54 U	0.588 U
N-ethyl perfluorooctanesulfonamidoacetic acid	--	--	--	UG/KG	0.254 UJ	0.572 U	0.54 U	0.588 U
Perfluorobutanesulfonic acid (PFBS)	--	--	--	UG/KG	0.254 U	0.572 U	0.54 U	0.588 U
Perfluorobutanoic Acid	--	--	--	UG/KG	0.254 U	0.134 J	0.095 J	0.091 J
Perfluorodecane Sulfonic Acid	--	--	--	UG/KG	0.254 UJ	0.572 U	0.54 U	0.588 U
Perfluorodecanoic acid (PFDA)	--	--	--	UG/KG	0.254 U	0.936	0.102 J	0.12 J
Perfluorododecanoic acid (PFDoA)	--	--	--	UG/KG	0.254 U	0.174 J	0.54 U	0.588 U
Perfluoroheptane Sulfonate (PFHPS)	--	--	--	UG/KG	0.254 U	0.572 U	0.54 U	0.588 U
Perfluoroheptanoic acid (PFHpA)	--	--	--	UG/KG	0.254 U	0.213 J	0.145 J	0.139 J
Perfluorohexanesulfonic acid (PFHxS)	--	--	--	UG/KG	0.254 U	0.08 J	0.54 U	0.588 U
Perfluorohexanoic acid (PFHxA)	--	--	--	UG/KG	0.254 U	0.368 JB	0.227 JB	0.227 JB
Perfluorononanoic acid (PFNA)	--	--	--	UG/KG	0.254 U	1.26	0.317 J	0.308 J
Perfluorooctane Sulfonamide (FOSA)	--	--	--	UG/KG	0.254 U	0.572 U	0.54 U	0.588 U
Perfluorooctanesulfonic acid (PFOS)	0.88	8.8	44	UG/KG	**0.957**	**9.02 J**	**4.98 J**	**4.38 J**
Perfluorooctanoic acid (PFOA)	0.66	6.6	33	UG/KG	0.254 U	**0.987 J**	0.567 J	0.49 J
Perfluoropentanoic Acid (PFPeA)	--	--	--	UG/KG	0.254 U	0.539 J	0.275 J	0.273 J
Perfluorotetradecanoic acid (PFTA)	--	--	--	UG/KG	0.254 UJ	0.079 J	0.54 U	0.588 U
Perfluorotridecanoic Acid (PFTriA)	--	--	--	UG/KG	0.254 U	0.572 U	0.54 U	0.588 U
Perfluoroundecanoic Acid (PFUnA)	--	--	--	UG/KG	0.254 UJ	0.1 J	0.078 J	0.066 J
Sodium 1H,1H,2H,2H-Perfluorodecane Sulfonate (8:2)	--	--	--	UG/KG	0.254 UJ	0.572 U	0.54 U	0.588 U
Sodium 1H,1H,2H,2H-Perfluorooctane Sulfonate (6:2)	--	--	--	UG/KG	0.254 U	0.572 U	0.54 U	0.588 U
TOTAL PFOA AND PFOS	--	--	--	UG/KG	NA	10	5.55	4.87 J

Table 9. Tracks 1, 2 and 4 Soil Cleanup Objectives
Sendero Verde Redevelopment Project- Parcel A, New York, NY

Parameter	Track 1 Unrestricted Use Soil Cleanup Objectives*	Track 2/4 Restricted Residential Use Soil Cleanup Objectives**
Volatile Organic Compounds (Concentrations in µg/kg)		
1,1,1-Trichloroethane	680	100000
1,1-Dichloroethane	270	26000
1,1-Dichloroethene	330	100000
1,2,4-Trimethylbenzene	3600	52000
1,3,5-Trimethylbenzene	8400	52000
1,2-Dichlorobenzene	1100	100000
1,2-Dichloroethane	20	3100
1,3-Dichlorobenzene	2400	49000
1,4-Dichlorobenzene	1800	13000
1,4-Dioxane	100	13000
2-Butanone (MEK)	120	100000
Acetone	50	100000
Benzene	60	4800
n-Butylbenzene	12000	100000
Carbon tetrachloride	760	2400
Chlorobenzene	1100	100000
Chloroform	370	49000
cis-1,2-Dichloroethene	250	100000
Ethylbenzene	1000	41000
Methylene chloride	50	100000
MTBE	930	100000
n-Propylbenzene	3900	100000
sec-Butylbenzene	11000	100000
tert-Butylbenzene	5900	100000
Tetrachloroethene	1300	19000
Toluene	700	100000
trans-1,2-Dichloroethene	190	100000
Trichloroethene	470	21000
Vinyl chloride	20	900
Xylenes (total)	260	100000
Semivolatile Organic Compounds (Concentrations in µg/kg)		
1,4-Dioxane	100	13000
2-Methylphenol	330	100000
3&4-Methylphenol	330	100000
Acenaphthene	20000	100000
Acenaphthylene	100000	100000
Anthracene	100000	100000
Benzo[a]anthracene	1000	1000
Benzo[a]pyrene	1000	1000
Benzo[b]fluoranthene	1000	1000
Benzo[g,h,i]perylene	100000	100000
Benzo[k]fluoranthene	800	3900
Chrysene	1000	3900
Dibenzo[a,h]anthracene	330	330
Dibenzofuran	7000	59000
Fluoranthene	100000	100000
Fluorene	30000	100000
Hexachlorobenzene	330	1200
Indeno[1,2,3-cd]pyrene	500	500
Naphthalene	12000	100000
Pentachlorophenol	800	6700
Phenanthrene	100000	100000
Phenol	330	100000
Pyrene	100000	100000

Table 9. Tracks 1, 2 and 4 Soil Cleanup Objectives
Sendero Verde Redevelopment Project- Parcel A, New York, NY

Parameter	Track 1 Unrestricted Use Soil Cleanup Objectives*	Track 2/4 Restricted Residential Use Soil Cleanup Objectives**
Metals (Concentrations in mg/kg)		
Arsenic	13	16
Barium	350	400
Beryllium	7.2	72
Cadmium	2.5	4.3
Chromium, Hexavalent	1	110
Chromium	30	180
Copper	50	270
Cyanide, Total	27	27
Lead	63	400
Manganese	1600	2000
Mercury	0.18	0.81
Nickel	30	310
Selenium	3.9	180
Silver	2	180
Zinc	109	10000
Pesticides (Concentrations in µg/kg)		
2,4,5-TP	3800	100000
4,4'-DDD	3.3	13000
4,4'-DDE	3.3	8900
4,4'-DDT	3.3	7900
Aldrin	5	97
alpha-BHC	20	480
alpha-Chlordane	94	4200
beta-BHC	36	360
delta-BHC	40	100000
Dieldrin	5	200
Endosulfan I	2400	24000
Endosulfan II	2400	24000
Endosulfan sulfate	2400	24000
Endrin	14	11000
gamma-BHC (Lindane)	100	1300
Heptachlor	42	2100
Pentachlorophenol	800	6700
Total Polychlorinated Biphenyls (Concentrations in µg/kg)		
Total Polychlorinated Biphenyls	100	1000

* Soil cleanup objectives for the Track 1 remedy are the NYSDEC Part 375 Unrestricted Residential Use SCOs.

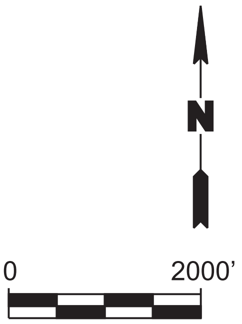
** Soil cleanup objectives for theTracks 2 and 4 remedy are the NYSDEC Part 375 Restricted Residential Use SCOs.
µg/kg - Micrograms per kilogram
mg/kg - Milligrams per kilogram

NYSDEC - New York State Department of Environmental Conservation
SCOs - Soil Cleanup Objectives

FIGURES

Noelle M. Clarke
No. 072491
12/13/22

QUADRANGLE LOCATION



SOURCE:
USGS; 2013, Central Park, NY
7.5 Minute Topographic Quadrangle

V:\CAD\PROJECTS\2984Y\0002Y\152\2984.0002Y152.01.CDR

Title:

SITE LOCATION MAP

SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

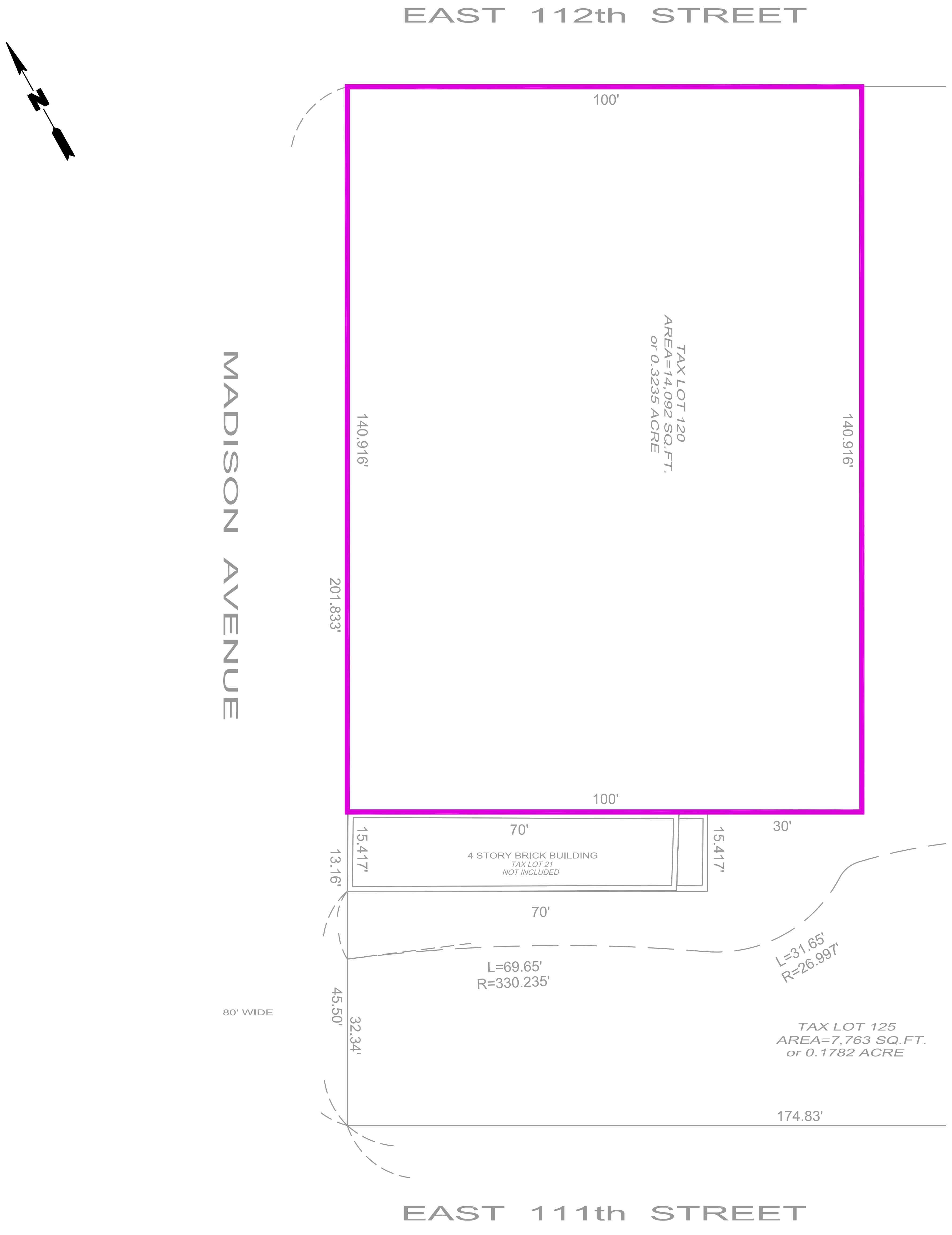
Prepared for:

SV-A OWNERS LLC

ROUX

Compiled by: N.C.	Date: 13DEC22	FIGURE
Prepared by: G.M.	Scale: AS SHOWN	1
Project Mgr: N.C.	Project: 2984.0002Y002	
File: 2984.0002Y152.01.CDR		

V:\CAD\PROJECTS\2984Y\0002Y\152\2984.0002Y152.02.DWG



LEGEND

▬ BCP SITE BOUNDARY

20' 0 20'

NOTES

1. BASEMAP ADAPTED FROM SURVEY NO. 65967-2 PREPARED BY MONTROSE SURVEYING CO., LLP, DATED FEBRUARY 1, 2019.
2. THE BUILDING FOOTPRINT COVERS THE ENTIRE BCP SITE.

Noelle M. Clarke
12/13/22

Title:

SITE LAYOUT MAP

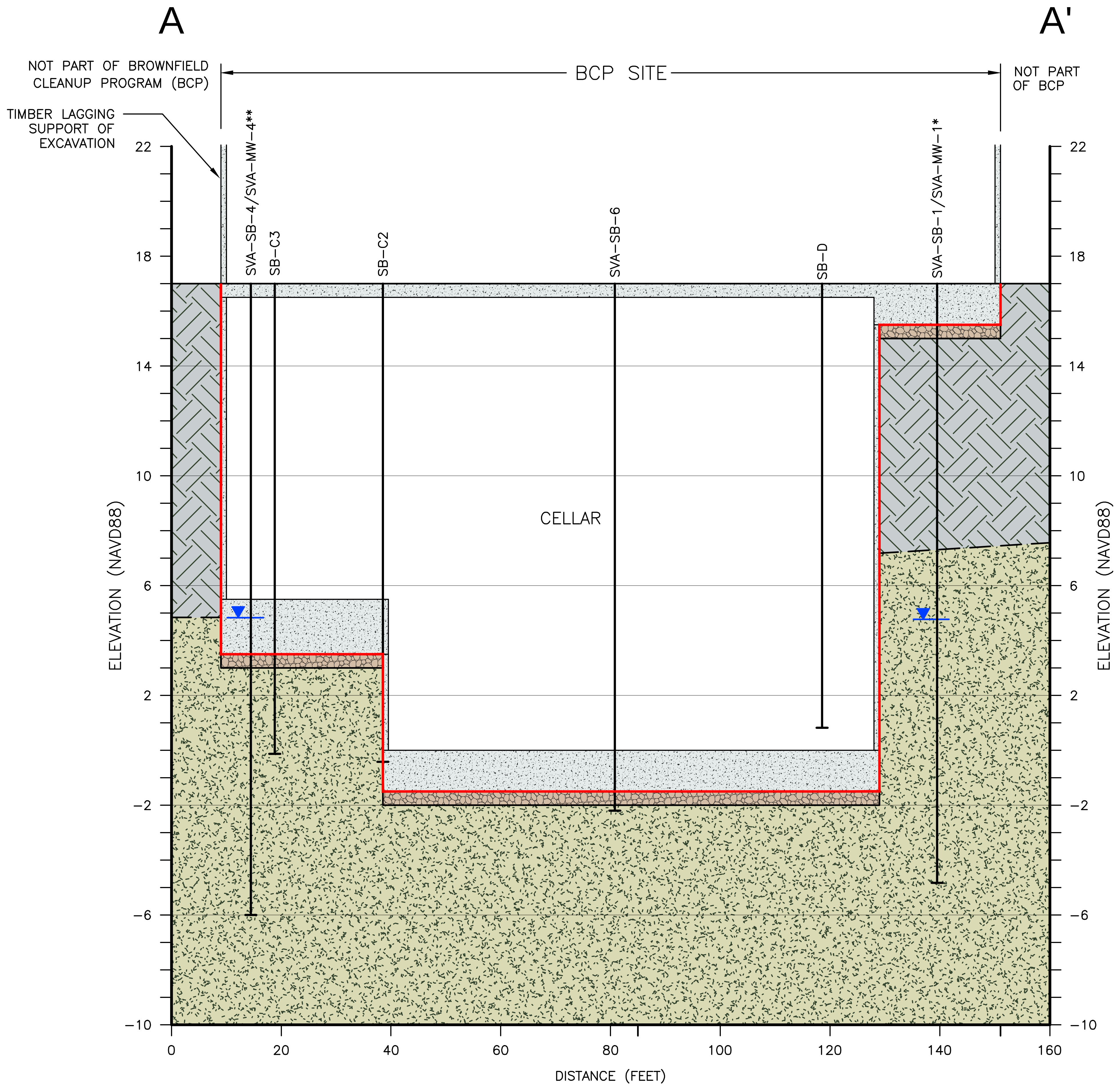
SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

Prepared for

SV-A OWNERS LLC

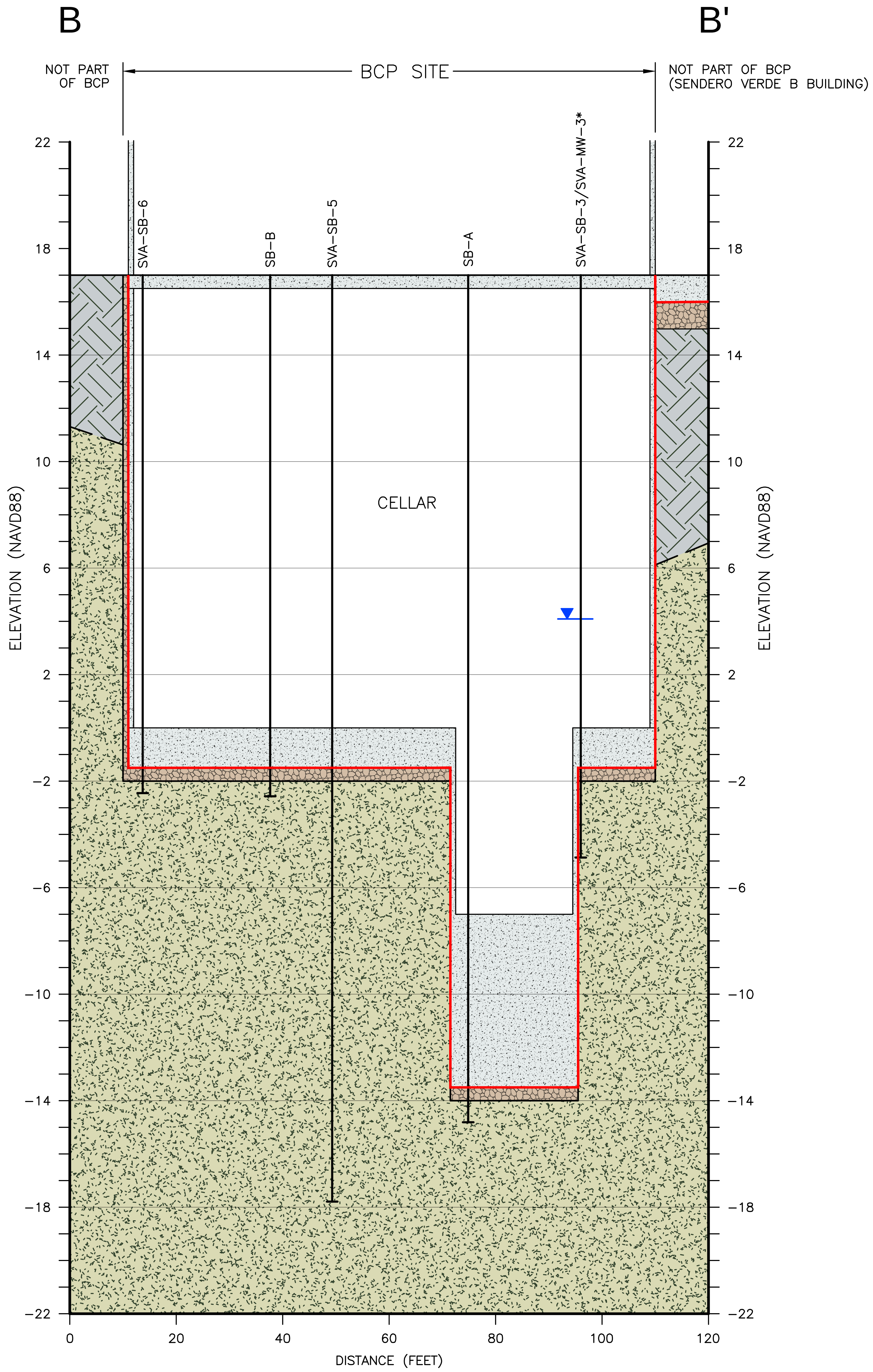
ROUX

Compiled by: B.V.	Date: 12DEC22	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	2
Project Mgr: B.V.	Project: 2984.0002Y002	
File: 2984.0002Y152.02.DWG		



SECTION A–A'

HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 4'

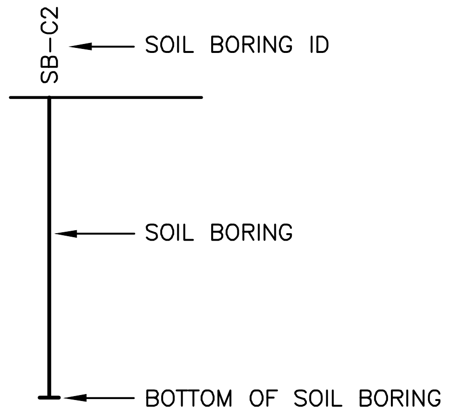


SECTION B–B'

HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 4'

LEGEND

- ▨ URBAN FILL
- ▨ SAND WITH VARYING AMOUNTS OF SILT AND GRAVEL
- ▨ CONCRETE FOUNDATION
- ▨ AREA EXCAVATED AND BACKFILLED WITH APPROVED NEW YORK STATE DEPARTMENT OF CONSERVATION BACKFILL
- — WATERPROOFING/VAPOR BARRIER DEMARCATION LAYER
- ▼ APPROXIMATE WATER TABLE ELEVATION



NOTES

NAVD88 – NORTH AMERICAN VERTICAL DATUM 1988

REFER TO FIGURE 3B FOR LOCATIONS OF HYDROGEOLOGIC CROSS SECTIONS

* SOIL BORINGS DESTROYED DURING REMEDIAL EXCAVATION

** TEMPORARY SOIL BORING DECOMMISSIONED FOLLOWING REMEDIAL INVESTIGATION ACTIVITIES

Noelle M. Clarke
No. 072431
12/13/22

Title:

HYDROGEOLOGIC CROSS SECTIONS

SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

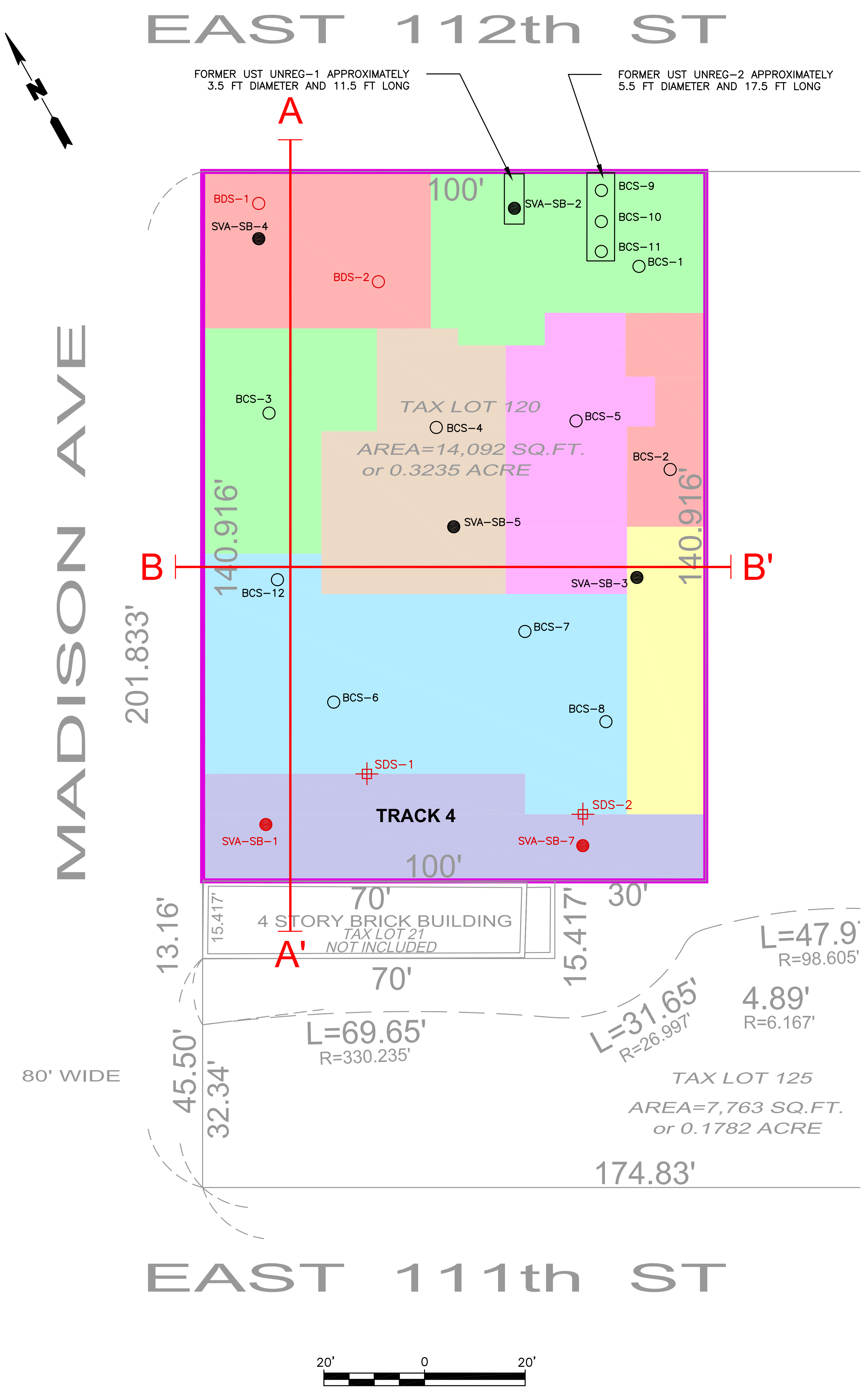
Prepared for:

SV-A OWNERS LLC

ROUX

Compiled by: B.H.	Date: 13DEC22	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	3A
Project Mgr: N.C.	Project: 2984.0002Y000	
File: 2984.0002Y152.04.DWG		

V:\CAD\PROJECTS\2984Y\0002Y\152\2984.0002Y152.04.DWG



LEGEND

▬	BCP SITE BOUNDARY
SVA–SB–2 ●	LOCATION AND DESIGNATION OF SRI SOIL BORING USED AS BCS
BCS–1 ○	APPROXIMATE LOCATION AND DESIGNATION OF BCS
BDS–1 ○	APPROXIMATE LOCATION AND DESIGNATION OF BDS
SVA–SB–1 ●	LOCATION AND DESIGNATION OF SRI SOIL BORING USED AS BDS
SDS–1 ⌖	APPROXIMATE LOCATION AND DESIGNATION OF SDS
UST	UNDERGROUND STORAGE TANK
SRI	SUPPLEMENTAL REMEDIAL INVESTIGATION
BCS	BOTTOM COFIRMATION SAMPLE
BDS	BOTTOM DOCUMENTATION SAMPLE
SDS	SIDEWALL DOCUMENTATION SAMPLE
BLS	BELOW LAND SURFACE
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
UUSCOs	NYSDEC PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES
RRSCOs	RESTRICTED RESIDENTIAL SOIL CLEANUP OBJECTIVES
PGWSCOs	PROTECTION OF GROUNDWATER SOIL CLEANUP OBJECTIVES
BCP	BROWNFIELD CLEANUP PROGRAM
UST	UNDERGROUND STORAGE TANK
├──┤	LINE OF GEOLOGIC CROSS SECTION

🟥	LIMITS OF TRACK 2 EXCAVATION TO APPROXIMATELY 15 FEET BLS
🟪	LIMITS OF TRACK 4 EXCAVATION TO APPROXIMATELY 2 FEET BLS.
🟨	LIMITS OF TRACK 1 EXCAVATION TO APPROXIMATELY 15 FEET BLS
🟦	LIMITS OF TRACK 1 EXCAVATION TO APPROXIMATELY 17 FEET BLS
🟩	LIMITS OF TRACK 1 EXCAVATION TO APPROXIMATELY 18 FEET BLS
🟫	LIMITS OF TRACK 1 EXCAVATION TO APPROXIMATELY 20 FEET BLS
🟪	LIMITS OF TRACK 1 EXCAVATION TO APPROXIMATELY 32 FEET BLS

NOTES

1. BASEMAP ADAPTED FROM SURVEY NO. 65967–2 PREPARED BY MONTROSE SURVEYING CO., LLP, DATED FEBRUARY 1, 2019.
2. THE BUILDING FOOT PRINT COVERS THE ENTIRE BCP SITE.

No. 072431

V:\CAD\PROJECTS\2984Y\0002Y\152\2984.0002Y152.05.DWG

NO.	DATE	REVISION DESCRIPTION	INT.

UNAUTHORIZED ALTERATION OR ADDITION TO THIS DOCUMENT IS A VIOLATION OF STATE LAW.

THESE DOCUMENTS (OR COPIES OF ANY THEREOF) PREPARED BY OR BEARING THE SEAL OF THE ENGINEER, SHALL NOT BE REUSED FOR ANY EXTENSIONS OF THE PROJECT OR ANY OTHER PROJECT WITHOUT THE WRITTEN CONSENT OF THE ENGINEER.

PROJ. ENGINEER: N.C.	DRAWN BY: B.H.C.
DESIGNED BY: N.C.	CHECKED BY: W.S.
DRAWING SCALE: AS SHOWN	PLOT SCALE: 1:1
DRAWING DATE: 12DEC22	PRINT TYPE: COLOR
OFFICE: NY	PAPER SIZE: ARCH D
PROJECT NO.: 2984.0002Y002	
DRAWING FILE: 2984.0002Y152.05.DWG	

ROUX
Roux Environmental
Engineering and Geology, D.P.C.
209 SHAFTER STREET ISLANDIA NEW YORK 11749
(631) 232-2600

PROJECT NAME:
SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A
PROJECT FOR:
SV-A OWNERS LLC

TITLE:
GENERAL CUT AND FILL MAP

FIGURE
3B

LEGEND

SB-C2 ●	APPROXIMATE LOCATION AND DESIGNATION OF WASTE CHARACTERIZATION SOIL BORING
SB-2 SV-2 ●	APPROXIMATE LOCATION AND DESIGNATION OF PHASE II ESA SOIL BORING AND SOIL VAPOR SAMPLE
SB-9 ●	APPROXIMATE LOCATION AND DESIGNATION OF PHASE II ESA SOIL BORING AND GROUNDWATER GRAB SAMPLE
SVA-SB-6/ SVA-SV-6 ■	APPROXIMATE LOCATION AND DESIGNATION OF SRI SOIL BORING AND SOIL VAPOR SAMPLE
SVA-SB-1/ SVA-SV-1/ SVA-MW-1 ▲	APPROXIMATE LOCATION AND DESIGNATION OF SRI SOIL BORING, SOIL VAPOR SAMPLE AND GROUNDWATER SAMPLE
▬	BCP SITE BOUNDARY
4.88	GROUNDWATER ELEVATION IN FT ASL
4.0 ──	INFERRED GROUNDWATER CONTOUR IN FT ASL
➞	INFERRED GROUNDWATER FLOW DIRECTION
SRI	SUPPLEMENTAL REMEDIAL INVESTIGATION

NOTES

1. BASEMAP ADAPTED FROM SURVEY NO. 65967-2 PREPARED BY MONTROSE SURVEYING CO., LLP, DATED FEBRUARY 1, 2019.
2. SRI SAMPLING LOCATIONS WERE SURVEYED ON DECEMBER 3, 2020. HORIZONTAL COORDINATES BASED UPON NY STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM (NAD) 83.

Noelle M. Clarke
No. 072491
12/13/22

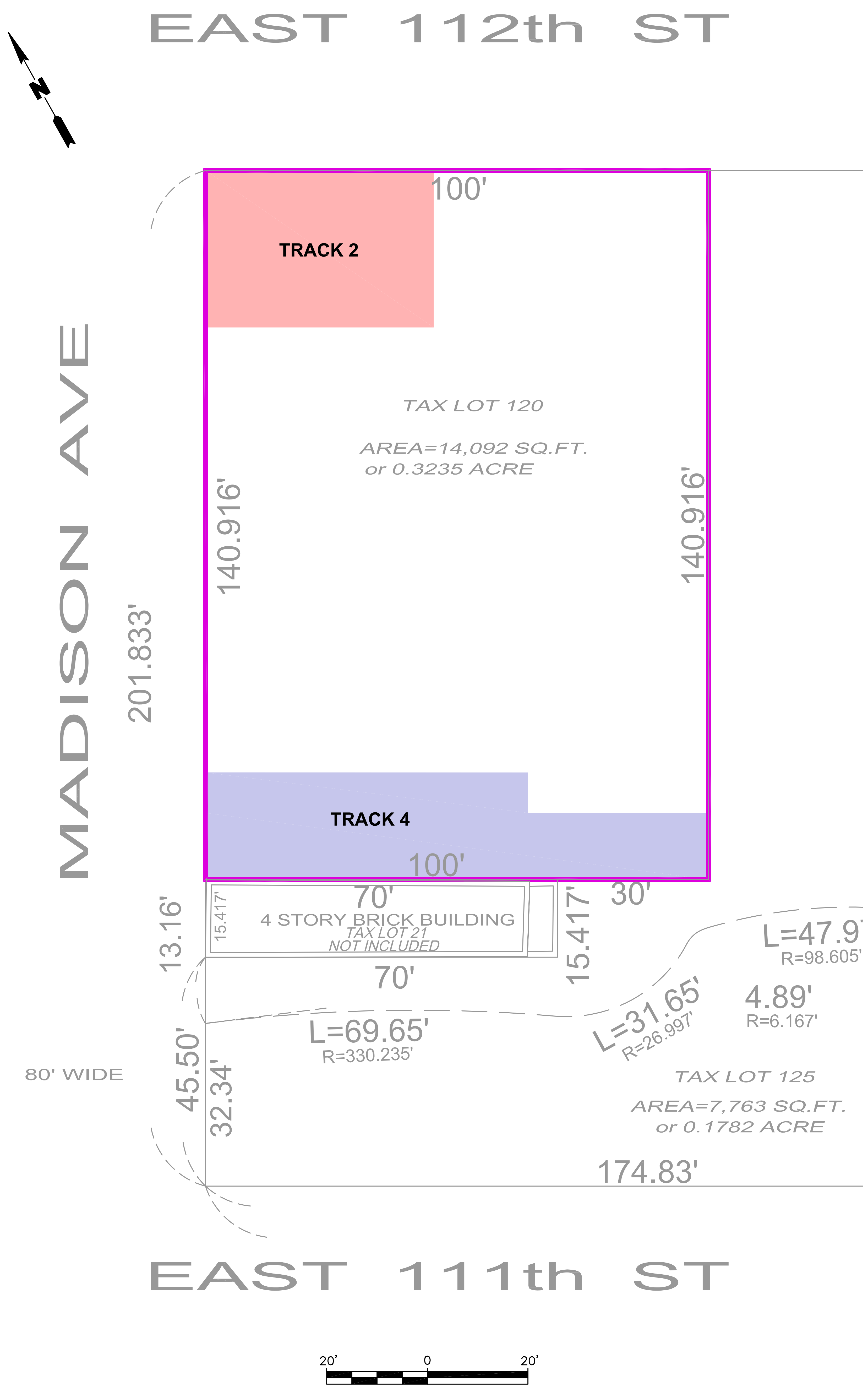
Title:
GROUNDWATER CONTOUR MAP
DECEMBER 3, 2020

SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

Prepared for
SV-A OWNERS LLC

ROUX

Compiled by: B.V.	Date: 08AUG22	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	4
Project Mgr: B.V.	Project: 2984.0002Y002	
File: 2984.0002Y152.02.DWG		



LEGEND

━	BCP SITE BOUNDARY
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
BCP	BROWNFIELD CLEANUP PROGRAM
🟪	TRACK 4 – RESTRICTED RESIDENTIAL
🟥	TRACK 2 – RESTRICTED RESIDENTIAL

NOTE

1. BASEMAP ADAPTED FROM SURVEY NO. 65967–2 PREPARED BY MONTROSE SURVEYING CO., LLP, DATED FEBRUARY 1, 2019.
2. THE BUILDING FOOTPRINT COVERS THE ENTIRE BCP SITE.
3. SEE APPENDIX A FOR ENVIRONMENTAL EASEMENT SURVEY.

Noelle M. Clarke
No. 072491
12/13/22

V:\CAD\PROJECTS\2984Y\0002Y\152\2984.0002Y152.03.DWG

NO.	DATE	REVISION DESCRIPTION	INT.

UNAUTHORIZED ALTERATION OR ADDITION TO THIS DOCUMENT IS A VIOLATION OF STATE LAW.

THESE DOCUMENTS (OR COPIES OF ANY THEREOF) PREPARED BY OR BEARING THE SEAL OF THE ENGINEER, SHALL NOT BE REUSED FOR ANY EXTENSIONS OF THE PROJECT OR ANY OTHER PROJECT WITHOUT THE WRITTEN CONSENT OF THE ENGINEER.

PROJ. ENGINEER: N.C.	DRAWN BY: B.H.C.
DESIGNED BY: N.C.	CHECKED BY: B.V.
DRAWING SCALE: AS SHOWN	PLOT SCALE: 1:1
DRAWING DATE: 12DEC22	PRINT TYPE: COLOR
OFFICE: NY	PAPER SIZE: ARCH D

PROJECT NO.: 2984.0002Y002

DRAWING FILE: 2984.0002Y152.03.DWG

ROUX
Roux Environmental
Engineering and Geology, D.P.C.
209 SHAFTER STREET ISLANDIA NEW YORK 11749
(631) 232-2600

PROJECT NAME:
SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

PROJECT FOR:
SV-A OWNERS LLC

TITLE:
INSTITUTIONAL CONTROL BOUNDARIES

FIGURE
5

APPENDICES

A. Environmental Easement, Site Survey and Metes & Bounds Description
B. List of Site Contacts
C. Soil Boring and Monitoring Well Logs
D. Excavation Work Plan
E. Health and Safety Plan (including CAMP)
F. Quality Assurance Project Plan/ Field Sampling Plan
G. Site Management Forms
H. Responsibilities of Owner and Remedial Party

APPENDIX A

Environmental Easement, Site Survey and Metes & Bounds Description

NYC DEPARTMENT OF FINANCE
OFFICE OF THE CITY REGISTER

This page is part of the instrument. The City Register will rely on the information provided by you on this page for purposes of indexing this instrument.The information on this page will control for indexing purposes in the event of any conflict with the rest of the document.

2022111600596002004E56F2

RECORDING AND ENDORSEMENT COVER PAGE

PAGE 1 OF 14

Document ID: 2022111600596002
Document Date: 10-24-2022
Preparation Date: 11-28-2022
Document Type: EASEMENT
Document Page Count: 12

PRESENTER:

SIVE PAGET & RIESEL, P.C.
560 LEXINGTON AVENUE, 15TH FLOOR
NEW YORK, NY 10022
212-421-2150
NDUNCAN@SPRLAW.COM

RETURN TO:

SIVE PAGET & RIESEL, P.C.
560 LEXINGTON AVENUE, 15TH FLOOR
NEW YORK, NY 10022
212-421-2150
NDUNCAN@SPRLAW.COM

PROPERTY DATA

Borough	Block	Lot	Unit	Address
MANHATTAN	1617	120 Entire Lot		N/A MADISON AVENUE

Property Type: OTHER Easement

CROSS REFERENCE DATA

CRFN_______ *or* DocumentID________ *or* _______ Year_____ Reel____ Page_____ *or* File Number__________

PARTIES

GRANTOR/SELLER:
ACACIA SENDERO HOUSING DEVELOPMENT FUND CORPORATIO
C/O: ACACIA NETWORK, INC., 300 E 175TH ST
BRONX, NY 10457-5833

☒ Additional Parties Listed on Continuation Page

GRANTEE/BUYER:
PEOPLE OF NEW YORK BY DEPT. ENVIRONMENTAL CONSERVA
625 BROADWAY
ALBANY, NY 12233

FEES AND TAXES

Mortgage :

Mortgage Amount:	$	0.00
Taxable Mortgage Amount:	$	0.00
Exemption:		
TAXES: County (Basic):	$	0.00
City (Additional):	$	0.00
Spec (Additional):	$	0.00
TASF:	$	0.00
MTA:	$	0.00
NYCTA:	$	0.00
Additional MRT:	$	0.00
TOTAL:	$	0.00
Recording Fee:	$	97.00
Affidavit Fee:	$	0.00

Filing Fee:	$	100.00
NYC Real Property Transfer Tax:	$	0.00
NYS Real Estate Transfer Tax:	$	0.00

RECORDED OR FILED IN THE OFFICE OF THE CITY REGISTER OF THE CITY OF NEW YORK

Recorded/Filed 11-30-2022 14:47
City Register File No.(CRFN):
2022000437885

1625

Annette M Hill

City Register Official Signature

NYC DEPARTMENT OF FINANCE
OFFICE OF THE CITY REGISTER

2022111600596002004C5472

RECORDING AND ENDORSEMENT COVER PAGE (CONTINUATION) **PAGE 2 OF 14**

Document ID: 2022111600596002 Document Date: 10-24-2022 Preparation Date: 11-28-2022
Document Type: EASEMENT

PARTIES

GRANTOR/SELLER: SV-A MODERATE OWNERS LLC C/O: JONATHAN ROSE COMPANIES, 551 FIFTH AVENUE, 23RD FLOOR NEW YORK, NY 10176	**GRANTOR/SELLER:** SV-A OWNERS LLC C/O: JONATHAN ROSE COMPANIES, 551 FIFTH AVENUE, 23RD FLOOR NEW YORK, NY 10176

ENVIRONMENTAL EASEMENT GRANTED PURSUANT TO ARTICLE 71, TITLE 36 OF THE NEW YORK STATE ENVIRONMENTAL CONSERVATION LAW

THIS INDENTURE made this 24th day of October, 2022 between Owner(s), **Acacia Sendero Verde Housing Development Fund Company, Inc.**, (the "Grantor Fee Owner") having an office at 300 East 175th Street, County of Bronx, State of New York, **SV-A Moderate Owners LLC**, (the "Grantor Beneficial Owner), having an office at 551 Fifth Avenue, 23rd Floor, County of New York, State of New York, and **SV-A Owners LLC** (the "Grantor LIHTC Tenant"), having an office at 551 Fifth Avenue, 23rd Floor, County of New York, State of New York (collectively, the "Grantor"), and **The People of the State of New York** (the "Grantee"), acting through their Commissioner of the Department of Environmental Conservation (the "Commissioner", or "NYSDEC" or "Department" as the context requires) with its headquarters located at 625 Broadway, Albany, New York 12233,

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to encourage the remediation of abandoned and likely contaminated properties ("sites") that threaten the health and vitality of the communities they burden while at the same time ensuring the protection of public health and the environment; and

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to establish within the Department a statutory environmental remediation program that includes the use of Environmental Easements as an enforceable means of ensuring the performance of operation, maintenance, and/or monitoring requirements and the restriction of future uses of the land, when an environmental remediation project leaves residual contamination at levels that have been determined to be safe for a specific use, but not all uses, or which includes engineered structures that must be maintained or protected against damage to perform properly and be effective, or which requires groundwater use or soil management restrictions; and

WHEREAS, the Legislature of the State of New York has declared that Environmental Easement shall mean an interest in real property, created under and subject to the provisions of Article 71, Title 36 of the New York State Environmental Conservation Law ("ECL") which contains a use restriction and/or a prohibition on the use of land in a manner inconsistent with engineering controls which are intended to ensure the long term effectiveness of a site remedial program or eliminate potential exposure pathways to hazardous waste or petroleum; and

WHEREAS, Grantor Fee Owner, is the owner of the fee interest in the real property located at the address of 50 East 112th Street in the City of New York, County of New York and State of New York, known and designated on the tax map of the New York City Department of Finance as tax map parcel number: Block 1617 Lot 120, being the same as that property conveyed to Grantor by deed dated June 24, 2021 and recorded in the City Register of the City of New York as CRFN #2021000251797. The property subject to this Environmental Easement (the "Controlled Property") comprises approximately 0.0756 +/- acres, and is hereinafter more fully described in the Land Title Survey dated June 14, 2022 prepared by Saeid Jalilvand of Montrose Surveying Co., LLP, which will be attached to the Site Management Plan. The Controlled Property description is set forth in and attached hereto as Schedule A; and

WHEREAS, Grantor Beneficial Owner, is the owner of the beneficial interest in the Controlled Property being the same as a portion of that beneficial interest conveyed to Grantor Beneficial Owner by means of a Declaration of Interest and Nominee Agreement dated June 24, 2021 and recorded in City Register of the City of New York as CRFN #2021000251798; and

WHEREAS, Grantor LIHTC Tenant, is the holder of a master lease interest in the Controlled Property, as memorialized in a Memorandum of Master Lease dated June 24, 2021 and recorded in the City Register of the City of New York as CRFN #2021000251799; and

WHEREAS, the Department accepts this Environmental Easement in order to ensure the protection of public health and the environment and to achieve the requirements for remediation established for the Controlled Property until such time as this Environmental Easement is extinguished pursuant to ECL Article 71, Title 36; and

NOW THEREFORE, in consideration of the mutual covenants contained herein and the terms and conditions of Brownfield Cleanup Agreement Index Number: C231135-09-19, as amended by Amendment #1 on September 15, 2021, Grantor conveys to Grantee a permanent Environmental Easement pursuant to ECL Article 71, Title 36 in, on, over, under, and upon the Controlled Property as more fully described herein ("Environmental Easement").

1. Purposes. Grantor and Grantee acknowledge that the Purposes of this Environmental Easement are: to convey to Grantee real property rights and interests that will run with the land in perpetuity in order to provide an effective and enforceable means of encouraging the reuse and redevelopment of this Controlled Property at a level that has been determined to be safe for a specific use while ensuring the performance of operation, maintenance, and/or monitoring requirements; and to ensure the restriction of future uses of the land that are inconsistent with the above-stated purpose.

2. Institutional and Engineering Controls. The controls and requirements listed in the Department approved Site Management Plan ("SMP") including any and all Department approved amendments to the SMP are incorporated into and made part of this Environmental Easement. These controls and requirements apply to the use of the Controlled Property, run with the land, are binding on the Grantor and the Grantor's successors and assigns, and are enforceable in law or equity against any owner of the Controlled Property, any lessees and any person using the Controlled Property.

A. (1) The Controlled Property may be used for:

Restricted Residential as described in 6 NYCRR Part 375-1.8(g)(2)(ii), Commercial as described in 6 NYCRR Part 375-1.8(g)(2)(iii) and Industrial as described in 6 NYCRR Part 375-1.8(g)(2)(iv)

(2) All Engineering Controls must be operated and maintained as specified in the Site Management Plan (SMP);

(3) All Engineering Controls must be inspected at a frequency and in a manner

defined in the SMP;

(4) The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the New York City Department of Health and Mental Hygiene to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department;

(5) Groundwater and other environmental or public health monitoring must be performed as defined in the SMP;

(6) Data and information pertinent to Site Management of the Controlled Property must be reported at the frequency and in a manner defined in the SMP;

(7) All future activities on the property that will disturb remaining contaminated material must be conducted in accordance with the SMP;

(8) Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in the SMP;

(9) Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical components of the remedy shall be performed as defined in the SMP;

(10) Access to the site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by this Environmental Easement.

B. The Controlled Property shall not be used for Residential purposes as defined in 6NYCRR 375-1.8(g)(2)(i), and the above-stated engineering controls may not be discontinued without an amendment or extinguishment of this Environmental Easement.

C. The SMP describes obligations that the Grantor assumes on behalf of Grantor, its successors and assigns. The Grantor's assumption of the obligations contained in the SMP which may include sampling, monitoring, and/or operating a treatment system, and providing certified reports to the NYSDEC, is and remains a fundamental element of the Department's determination that the Controlled Property is safe for a specific use, but not all uses. The SMP may be modified in accordance with the Department's statutory and regulatory authority. The Grantor and all successors and assigns, assume the burden of complying with the SMP and obtaining an up-to-date version of the SMP from:

Site Control Section
Division of Environmental Remediation
NYSDEC
625 Broadway
Albany, New York 12233
Phone: (518) 402-9553

D. Grantor must provide all persons who acquire any interest in the Controlled Property a true and complete copy of the SMP that the Department approves for the Controlled Property and all Department-approved amendments to that SMP.

E. Grantor covenants and agrees that until such time as the Environmental Easement is extinguished in accordance with the requirements of ECL Article 71, Title 36 of the ECL, the property deed and all subsequent instruments of conveyance relating to the Controlled Property shall state in at least fifteen-point bold-faced type:

This property is subject to an Environmental Easement held by the New York State Department of Environmental Conservation pursuant to Title 36 of Article 71 of the Environmental Conservation Law.

F. Grantor covenants and agrees that this Environmental Easement shall be incorporated in full or by reference in any leases, licenses, or other instruments granting a right to use the Controlled Property.

G. Grantor covenants and agrees that it shall, at such time as NYSDEC may require, submit to NYSDEC a written statement by an expert the NYSDEC may find acceptable certifying under penalty of perjury, in such form and manner as the Department may require, that:

(1) the inspection of the site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under the direction of the individual set forth at 6 NYCRR Part 375-1.8(h)(3).

(2) the institutional controls and/or engineering controls employed at such site:

(i) are in-place;

(ii) are unchanged from the previous certification, or that any identified changes to the controls employed were approved by the NYSDEC and that all controls are in the Department-approved format; and

(iii) that nothing has occurred that would impair the ability of such control to protect the public health and environment;

(3) the owner will continue to allow access to such real property to evaluate the continued maintenance of such controls;

(4) nothing has occurred that would constitute a violation or failure to comply with any site management plan for such controls;

(5) the report and all attachments were prepared under the direction of, and reviewed by, the party making the certification;

(6) to the best of his/her knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program, and generally accepted engineering practices; and

(7) the information presented is accurate and complete.

3. <u>Right to Enter and Inspect</u>. Grantee, its agents, employees, or other representatives of the

State may enter and inspect the Controlled Property in a reasonable manner and at reasonable times to assure compliance with the above-stated restrictions.

4. Reserved Grantor's Rights. Grantor reserves for itself, its assigns, representatives, and successors in interest with respect to the Property, all rights as fee owner of the Property, including:

A. Use of the Controlled Property for all purposes not inconsistent with, or limited by the terms of this Environmental Easement;

B. The right to give, sell, assign, or otherwise transfer part or all of the underlying fee interest to the Controlled Property, subject and subordinate to this Environmental Easement;

5. Enforcement

A. This Environmental Easement is enforceable in law or equity in perpetuity by Grantor, Grantee, or any affected local government, as defined in ECL Section 71-3603, against the owner of the Property, any lessees, and any person using the land. Enforcement shall not be defeated because of any subsequent adverse possession, laches, estoppel, or waiver. It is not a defense in any action to enforce this Environmental Easement that: it is not appurtenant to an interest in real property; it is not of a character that has been recognized traditionally at common law; it imposes a negative burden; it imposes affirmative obligations upon the owner of any interest in the burdened property; the benefit does not touch or concern real property; there is no privity of estate or of contract; or it imposes an unreasonable restraint on alienation.

B. If any person violates this Environmental Easement, the Grantee may revoke the Certificate of Completion with respect to the Controlled Property.

C. Grantee shall notify Grantor of a breach or suspected breach of any of the terms of this Environmental Easement. Such notice shall set forth how Grantor can cure such breach or suspected breach and give Grantor a reasonable amount of time from the date of receipt of notice in which to cure. At the expiration of such period of time to cure, or any extensions granted by Grantee, the Grantee shall notify Grantor of any failure to adequately cure the breach or suspected breach, and Grantee may take any other appropriate action reasonably necessary to remedy any breach of this Environmental Easement, including the commencement of any proceedings in accordance with applicable law.

D. The failure of Grantee to enforce any of the terms contained herein shall not be deemed a waiver of any such term nor bar any enforcement rights.

6. Notice. Whenever notice to the Grantee (other than the annual certification) or approval from the Grantee is required, the Party providing such notice or seeking such approval shall identify the Controlled Property by referencing the following information:

County, NYSDEC Site Number, NYSDEC Brownfield Cleanup Agreement, State Assistance Contract or Order Number, and the County tax map number or the Liber and Page or computerized system identification number.

Parties shall address correspondence to:

Site Number: C231135
Office of General Counsel
NYSDEC
625 Broadway
Albany New York 12233-5500

With a copy to:

Site Control Section
Division of Environmental Remediation
NYSDEC
625 Broadway
Albany, NY 12233

All notices and correspondence shall be delivered by hand, by registered mail or by Certified mail and return receipt requested. The Parties may provide for other means of receiving and communicating notices and responses to requests for approval.

7. Recordation. Grantor shall record this instrument, within thirty (30) days of execution of this instrument by the Commissioner or her/his authorized representative in the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

8. Amendment. Any amendment to this Environmental Easement may only be executed by the Commissioner of the New York State Department of Environmental Conservation or the Commissioner's Designee, and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

9. Extinguishment. This Environmental Easement may be extinguished only by a release by the Commissioner of the New York State Department of Environmental Conservation, or the Commissioner's Designee, and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

10. Joint Obligation. If there are two or more parties identified as Grantor herein, the obligations imposed by this instrument upon them shall be joint and several.

11. Consistency with the SMP. To the extent there is any conflict or inconsistency between the terms of this Environmental Easement and the SMP, regarding matters specifically addressed by the SMP, the terms of the SMP will control.

Remainder of Page Intentionally Left Blank

IN WITNESS WHEREOF, Grantor Fee Owner has caused this instrument to be signed in its name.

Acacia Sendero Verde Housing Development Fund Company, Inc.:

By: ____________________

Print Name: ___Raul Russi____________________

Title:____President______________ Date:____________

Grantor Fee Owner's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF Bronx)

On the 13th day of October, in the year 2022, before me, the undersigned, personally appeared _Raul Russi_, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/ her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Notary Public – State of New York

GIAMARA M. ROSADO
Notary Public, State of New York
Registration #02RO6305162
Qualified in Bronx County
Commission Expires June 2, 2026

SEAL

IN WITNESS WHEREOF, Grantor Beneficial Owner has caused this instrument to be signed in its name.

SV-A Moderate Owners LLC:

By: ______________________

Print Name: Michael Arman

Title: Authorized Signatory Date: 10/12/2022

Grantor Beneficial Owner's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF New York)

On the 12th day of October, in the year 2022, before me, the undersigned, personally appeared Michael Arman, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Courtney Casale
Notary Public - State of New York

COURTNEY CASALE
NOTARY PUBLIC, STATE OF NEW YORK
Registration No. 01CA6355472
Qualified In Nassau County
Commission Expires March 6, 202[illegible]

SEAL

IN WITNESS WHEREOF, Grantor LIHTC Tenant has caused this instrument to be signed in its name.

SV-A Owners LLC:

By: ______________________

Print Name: Michael Arman

Title: Authorized Signatory Date: 10/12/2022

Grantor LIHTC Tenant's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF New York)

On the 12th day of October, in the year 2022 before me, the undersigned, personally appeared Michael Arman, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Courtney Casale
Notary Public - State of New York

COURTNEY CASALE
NOTARY PUBLIC, STATE OF NEW YORK
Registration No. 01CA6355472
Qualified in Nassau County
Commission Expires March 6, 2025

SEAL

THIS ENVIRONMENTAL EASEMENT IS HEREBY ACCEPTED BY THE PEOPLE OF THE STATE OF NEW YORK, Acting By and Through the Department of Environmental Conservation as Designee of the Commissioner,

By: ______________________________
Andrew O. Guglielmi, Director
Division of Environmental Remediation

Grantee's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF ALBANY)

On the 24th day of October, in the year 2022 before me, the undersigned, personally appeared Andrew O. Guglielmi, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/ executed the same in his/her/ capacity as Designee of the Commissioner of the State of New York Department of Environmental Conservation, and that by his/her/ signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument.

____
Notary Public - State of New York

JENNIFER ANDALORO
Notary Public, State of New York
No. 02AN6098246
Qualified in Albany County
Commission Expires January 14, 2024

SEAL

SCHEDULE "A" PROPERTY DESCRIPTION

PARCEL DESCRIPTION

ALL that certain plot, piece or parcel of land situate, lying and being in the Borough of Manhattan, County, City and State of New York, bounded and described as follows:

BEGINNING at the corner formed by the intersection of the southerly side of East 112th Street (80 feet wide) with the easterly side of Madison Avenue (80 feet wide);

RUNNING THENCE easterly along the southerly side of East 112th Street, 100 feet to a point;

RUNNING THENCE southerly at right angles with the southerly side of East 112th Street, 140 feet 11 inches to a point;

RUNNING THENCE westerly at right angles to the last mentioned course, 100 feet to the easterly side of Madison Avenue;

RUNNING THENCE northerly along the easterly side of Madison Avenue, 140 feet 11 inches to the corner of the point or place of BEGINNING.

The above described Lot 120 Parcel Area having an area of 14,092 square feet or 0.3235 Acre.

ENVIRONMENTAL EASEMENT AREA 1 – TRACK 4 RESTRICTED RESIDENTIAL

All that certain plot piece or parcel of land situate, lying and being in the Borough of Manhattan, County, City and State of New York, bounded and described as follows:

BEGINNING at a point on the easterly side of Madison Avenue (80 feet wide) distant 140 feet 11 inches southerly from the corner formed by the intersection of the southerly side of East 112th Street (80 feet wide) with the easterly side of Madison Avenue;

RUNNING THENCE easterly at right angles to the easterly side of Madison Avenue, 100 feet to a point;

RUNNING THENCE northerly at right angles to the last mentioned course, 13 feet 6 inches to a point;

RUNNING THENCE westerly at right angles to the last mentioned course, 36 feet to a point;

RUNNING THENCE northerly at right angles to the last mentioned course, 8 feet to a point;

RUNNING THENCE westerly at right angles to the easterly side of Madison Avenue, 64 feet to the easterly side of Madison Avenue;

RUNNING THENCE southerly along the easterly side of Madison Avenue, 21 feet 6 inches to the point or place of BEGINNING.

The above described Environmental Easement Area 1 having an area of 1,862 square feet or 0.0427 Acre.

ENVIRONMENTAL EASEMENT AREA 2 – TRACK 2 RESTRICTED RESIDENTIAL

All that certain plot piece or parcel of land situate, lying and being in the Borough of Manhattan, County, City and State of New York, bounded and described as follows:

BEGINNING at a corner formed by the intersection of the southerly side of East 112th Street (80 feet wide) with the easterly side of Madison Avenue (80 feet wide);

RUNNING THENCE southerly along the easterly side of Madison Avenue, 31 feet 6 inches to a point;

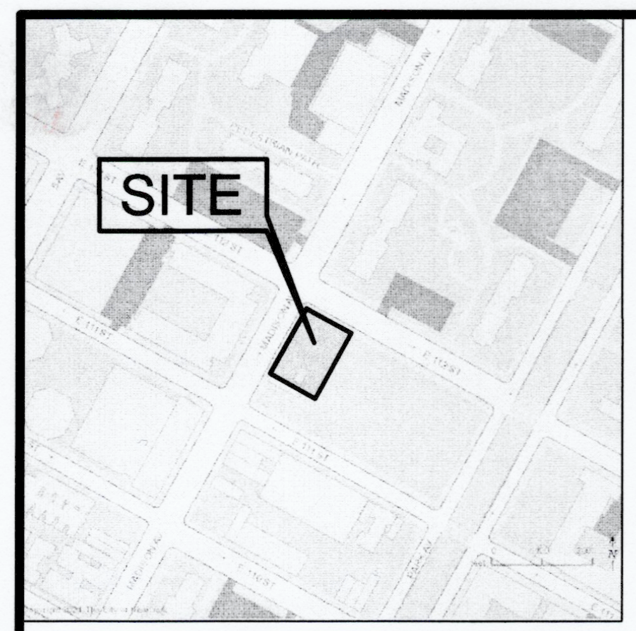
RUNNING THENCE easterly at right angles to the easterly side of Madison Avenue, 45 feet 6 inches to a point;

RUNNING THENCE northerly at right angles to the last mentioned course, 31 feet 6 inches to the southerly side of East 112th Street;

RUNNING THENCE westerly along the southerly side of East 112th Street, 45 feet 6 inches to the easterly side of Madison Avenue the corner the point or place of BEGINNING.

The above described Environmental Easement Area 2 having an area of 1,433 square feet or 0.0329 Acre.

TITLE NO. MTAL-421



VICINITY MAP
NOT TO SCALE

SURVEY NO. 65967–90

65967–90.DWG
65967–51.CRD

ENVIRONMENTAL EASEMENT DESCRIPTION

Environmental Easement Area 2
Track 2 Restricted Residential

All that certain plot piece or parcel of land situate lying and being in the Borough of Manhattan, City, County and State of New York bounded and described as follows:

BEGINNING at a corner formed by the intersection of the southerly side of East 112th Street (80 feet wide) with the easterly side of Madison Avenue (80 feet wide);

RUNNING THENCE southerly along the easterly side of Madison Avenue, 31 feet 6 inches to a point;

RUNNING THENCE easterly at right angles to the easterly side of Madison Avenue, 45 feet 6 inches to a point;

RUNNING THENCE northerly at right angles to the last mentioned course, 31 feet 6 inches to the southerly side of East 112th Street,

RUNNING THENCE westerly along the southerly side of East 112th Street, 45 feet 6 inches to the easterly side of Madison Avenue the corner the point or place of BEGINNING.

The above described Environmental Easement Area 2 having an area of 1,433 square feet or 0.0329 Acre.

Easement Area 1
Track 4 Restricted Residential

All that certain plot piece or parcel of land situate lying and being in the Borough of Manhattan, City, County and State of New York bounded and described as follows:

BEGINNING at a point on the easterly side of Madison Avenue (80 feet wide) distant 140 feet 11 inches southerly from the corner formed by the intersection of the southerly side of East 112th Street (80 feet wide) with the easterly side of Madison Avenue;

RUNNING THENCE easterly at right angles to the easterly side of Madison Avenue, 100 feet to a point;

RUNNING THENCE northerly at right angles to the last mentioned course, 13 feet 6 inches to a point;

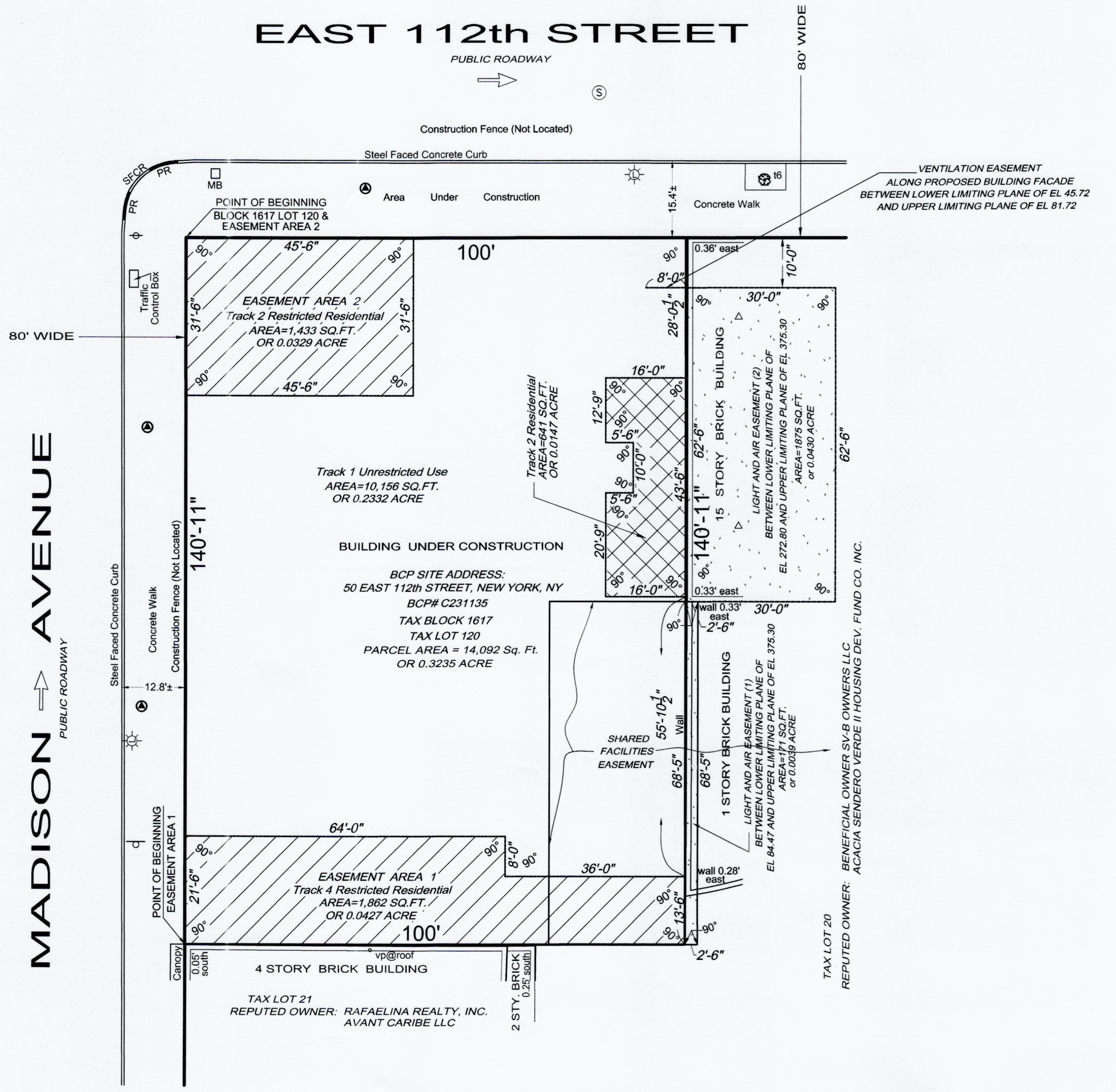
RUNNING THENCE westerly at right angles to the last mentioned course, 36 feet to a point;

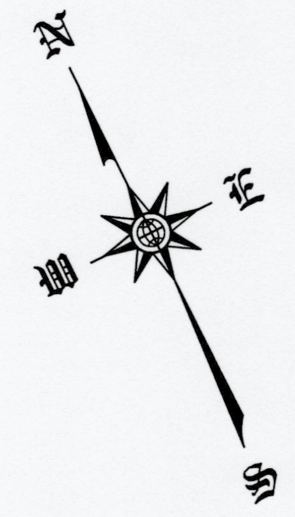
RUNNING THENCE northerly at right angles to the last mentioned course, 8 feet to a point;

RUNNING THENCE westerly at right angles to the easterly side of Madison Avenue, 64 feet to the easterly side of Madison Avenue;

RUNNING THENCE southerly along the easterly side of Madison Avenue, 21 feet 6 inches to the point or place of BEGINNING.

The above described Environmental Easement Area 1 having an area of 1,862 square feet or 0.0427 Acre.





LEGEND

ASPH.....ASPHALT
BK..........BRICK
BSMT.....BASEMENT
CC..........CURB CUT
CCR.......CONCRETE CURB ROUND
CD..........CELLAR DOOR
CLF........CHAIN LINK FENCE
CO..........CATCH BASIN CLEAN OUT
CONC.....CONCRETE
CRF........CHAIN ROPE FENCE
CWA.......CELLAR WINDOW AREA
DR..........DRAIN
EL...........ELEVATION
FAB........FIRE ALARM BOX
FC..........FILL CAP
FL EL.....FLOOR ELEVATION
GP..........GUARD POLE
GV..........GAS VALVE
IF...........IRON FENCE
INL.........CATCH BASIN INLET ELEVATION
INV.........SEWER INVERT ELEVATION
Ⓛ.........LIGHT POLE
MB..........MAIL BOX
MHU.......UNKNOWN MANHOLE
OF..........OIL FILL
OHW......OVERHEAD WIRES
P............POLE
PAVT......PAVEMENT
PM..........PARKING METER
CATV......CABLE TV BOX
PMULT...POLE, MULTIPLE USAGE
..........SPRINKLER

PR..........PEDESTRIAN RAMP
RET........RETAINING
RIM........RIM ELEVATION SEWER MANHOLE
SFCR.....STEEL FACED CURB ROUND
STY........STORY
TB..........TOP OF BANK ELEVATION
ϕ...........TRAFFIC LIGHT
TEL........TELEPHONE
TP..........TREE PIT
...........TRAFFIC SIGN
TW.........ELEVATION AT TOP OF WALL
UP.........UTILITY POLE
VU.........VALVE UNKNOWN
VLTU......VAULT UNKNOWN
VP.........VENT PIPE
WV.........WATER VALVE
12"G.......GAS MAIN WITH SIZE
12"S.......SEWER MAIN WITH SIZE
12"W......WATER MAIN WITH SIZE
▥.......CATCH BASIN
Ⓔ E...ELECTRIC MANHOLE / VAULT
Ⓕ ....FIRE MANHOLE
Ⓖ ....GAS MANHOLE
Ⓢ ....SEWER MANHOLE
Ⓣ ....TELEPHONE MANHOLE
Ⓦ ....WATER MANHOLE
ST ....STEAM MANHOLE
STV........STEAM VALVE
TR.........TRAFFIC VAULT
.........HYDRANT
t4 .....TREE WITH SIZE
⇨....TRAFFIC FLOW
▲......... MONITORING WELL

FLOOD HAZARD NOTE

THE PARCEL SURVEYED IS COMPRISED OF AREAS DESIGNATED AS
ZONE X (LESS THAN 0.2% CHANCE OF FLOODING)
FEDERAL EMERGENCY MANAGEMENT AGENCY
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
COMMUNITY PANEL NUMBER 360497 0087 F
EFFECTIVE DATE SEPTEMBER 5, 2007

▨ ENVIRONMENTAL EASEMENT BOUNDARY

ENVIRONMENTAL EASEMENT AREA ACCESS

THE DEC OR THEIR AGENT MAY ACCESS THE ENVIRONMENTAL EASEMENT AREA AS SHOWN HEREON THROUGH ANY EXISTING STREET ACCESS OR BUILDING INGRESS/EGRESS ACCESS POINT.

20 0 20 40 60
GRAPHIC SCALE – FEET

0 2.4 4.8 7.2 9.6M
1 CM = 2.4 M

DRAWN: GP

ESTABLISHED 1876 * SUCCESSOR TO:
B.G. MEINIKHEIM C.S.*C.U. POWELL C.E.,C.S.*L.C.L. SMITH C.S.*NATHAN CAMPBELL C.E.,C.S.*A.U. WHITSON C.E.,C.S.*
WILLIAM L. SAVACOOL C.E.,L.S.,C.S.*A.U. WHITSON INC. C.E.,C.S.*G. WEBER L.S.,C.S.*C. STIDOLPH R.A.,L.S.*WHITSON &
POWELL INC. P.E.,L.S.,C.S.*KELLER & POWELL P.E.,L.S.,C.S.*LOUIS MONTROSE C.E.,L.S.,C.S.*FRED J. POWELL P.E.,L.S.,C.S.*

REMEDIAL CLEANUP TRACKS

Sendero Verde Redevelopment Project –
Parcel A
C231135
50 East 112th Street, New York, NY 10029

REV	DATE	DESCRIPTION	ck

REV	DATE	DESCRIPTION	ck
	10-07-22	REMEDIAL CLEANUP TRACK DIAGRAM	
A			

UNAUTHORIZED ALTERATION OR ADDITION TO THIS SURVEY IS A VIOLATION OF SECTION 7209 OF THE NEW YORK STATE EDUCATION LAW

ONLY COPIES FROM THE ORIGINAL OF THIS SURVEY MARKED WITH AN ORIGINAL OF THE LAND SURVEYOR'S INKED SEAL OR HIS EMBOSSED SEAL SHALL BE CONSIDERED TO BE VALID TRUE COPIES

CERTIFICATIONS INDICATED HEREON SHALL RUN ONLY TO THE PERSON FOR WHOM THE SURVEY IS PREPARED AND ON HIS BEHALF TO THE TITLE COMPANY. GOVERNMENTAL AGENCY AND LENDING INSTITUTION LISTED HEREON, AND TO THE ASSIGNEES OF THE LENDING INSTITUTION, CERTIFICATIONS ARE NOT TRANSFERABLE TO ADDITIONAL INSTITUTIONS OR SUBSEQUENT OWNERS

MONTROSE
SURVEYING CO., LLP.
CITY & LAND SURVEYORS
116 20 METROPOLITAN AVE * RICHMOND HILL NY 11418–1090 * (718) 849–0600

SAEID JALILVAND
050236

CITY OF NEW YORK
COUNTY NEW YORK
TAX BLOCK 1617
TAX LOT 120

SCALE: 1" = 20'

APPENDIX B

List of Site Contacts

APPENDIX B – LIST OF SITE CONTACTS

Name	**Phone/Email Address**
Sabrina Barker, L+M Development Partners Inc., Site Owner	Phone: (253) 632-2204 Email: sbarker@lmdevpartners.com
Noelle M. Clarke, P.E., Roux, Environmental Consultant and Remedial Engineer	Phone: (631) 232-2600 Email: nclarke@rouxinc.com
Steven Wu, NYSDEC Project Manager	Phone: (718) 482-6725 Email: steven.wu@dec.ny.gov
Andre A. Obligado, NYSDEC Section Chief	Phone: (718) 482-6412 Email: andre.obligado@dec.ny.gov
Kelly Lewandowski, NYSDEC Site Control Section Chief	Phone: (518) 402-9569 Email: kelly.lewandowski@dec.ny.gov
Michael Bogin, Remedial Party Attorney	Phone: (646) 378-7210 Email: mbogin@sprlaw.com
Mark Sergott, NYSDOH Project Manager	Phone: (518) 473-0771 Email: mark.sergott@health.ny.gov

APPENDIX C

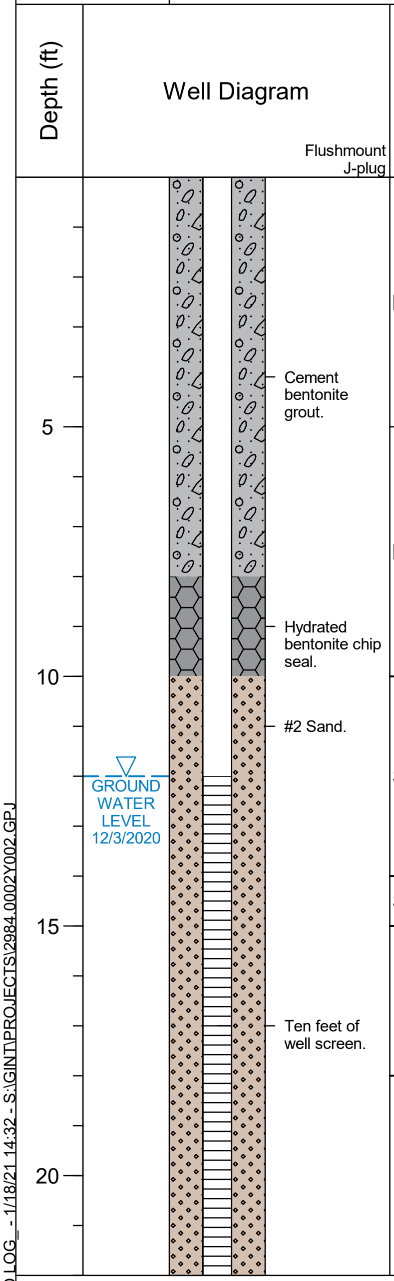
Soil Boring and Monitoring Well Logs

SVA-SB-1/MW-1

Client: SV-A Owners LLC	Site: Sendero Verde - Parcel A	Project Number: 2984.0002Y002
Address: 50 East 112th Street	City/State: New York, New York	Logged By: L. Lai

Start to Finish Date: 11/23/2020 - 11/23/2020	Contractor: AARCO	Drill Type: Geoprobe	Sampler Type/Method: 2" Macro-Core
Borehole Depth: 22 feet	Backfill: Clean cuttings	Borehole Diameter: 2-inches	DTW: 12 feet
Area: Block 1617 Lot 120	Elevation: 16.98	Northing: 229639.49	Easting: 998973.44

Well Depth: 22 feet	Well Dia./Materials: 2-inch SCH 40 PVC	Screen Interval: 12-22 feet	Screen Slot Size: 0.02-Slot	Sand/Filter Pack Size: #2	Annular Seal: Bentonite Chips



Depth (ft)	USCS	Visual Description	Sample Interval	Recovery (ft)	PID	Notes
0	MIXD	Brown, fine to coarse SAND, some Silt, Cobble, Gravel, and Brick (FILL); moist.	G	6	0.4	Hand cleared to 6 feet bls. Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-1 (0-2). Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-1 (2-4).
5	MIXD	Grey brown, fine to coarse SAND, some Silt, Gravel, Cobble, Brick (FILL); moist.		3	0.3	Collect sample for TCL/Part 375+30/TAL full list at SB-1 (4-6).
10	SWG	Reddish brown, fine to coarse SAND, some Gravel, little Silt; moist.		3	0.2 0.2	
14	SWG	Reddish brown, fine to coarse SAND, some Gravel, little Silt; wet.				
15	SW-SM	Light brown, fine to coarse SAND, some silt, little Gravel; wet.		4	0.2 0.2	Collect sample for TCL/Part 375+30/TAL full list at SB-1 (15-17).
18	SW-SM	Brown, fine to coarse SAND, some Silt; wet.				End of boring at 22 ft bls.

Bottom of borehole at 22 feet

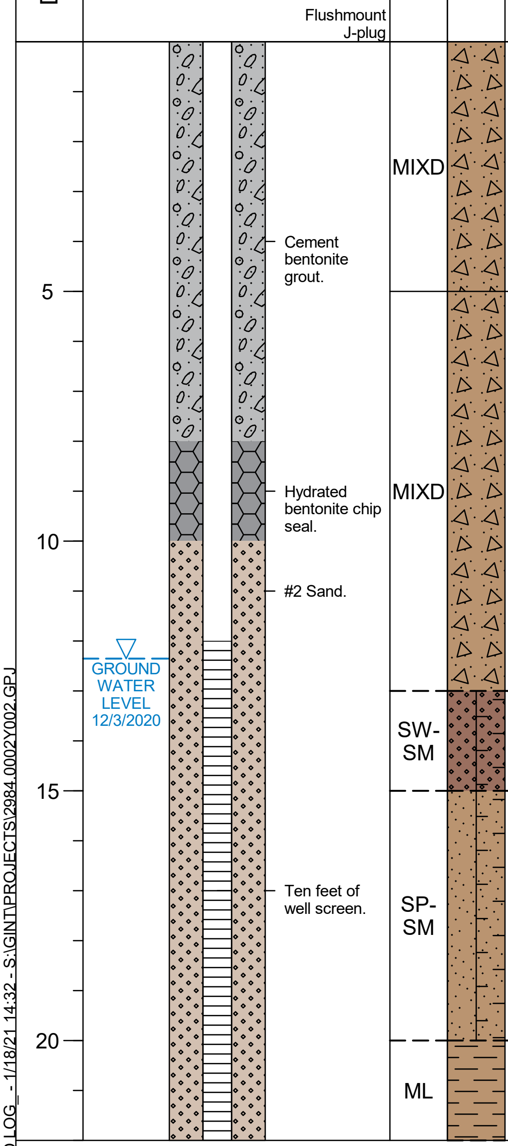
SVA-SB-2/MW-2

Client: SV-A Owners LLC	Site: Sendero Verde - Parcel A	Project Number: 2984.0002Y002
Address: 50 East 112th Street	City/State: New York, New York	Logged By: L. Lai

Start to Finish Date: 11/20/2020 - 11/20/2020	Contractor: AARCO	Drill Type: Geoprobe	Sampler Type/Method: 2" Macro-Core
Borehole Depth: 22 feet	Backfill: Clean cuttings	Borehole Diameter: 2-inches	DTW: 12.35 feet
Area: Block 1617 Lot 120	Elevation: 17.33	Northing: 229723.23	Easting: 999078.32

Well Depth: 22 feet	Well Dia./Materials: 2-inch SCH 40 PVC	Screen Interval: 12-22 feet	Screen Slot Size: 0.02-Slot	Sand/Filter Pack Size: #2	Annular Seal: Bentonite Chips

Depth (ft) | Well Diagram | USCS | USCS Graphic



USCS	Visual Description
MIXD	Brown, fine to coarse SAND, some Gravel and Cobble, trace brick (FILL); moist.
MIXD	Brown, fine to coarse SAND, some Cobble, little Gravel, trace brick (FILL); moist.
SW-SM	Reddish brown, fine to coarse SAND, little Silt; wet.
SP-SM	Brown, fine to medium SAND, little Silt; wet.
ML	Brown, SILT; wet.

Bottom of borehole at 22 feet

Sample Interval	Recovery (ft)	PID
G	5	0.0
	3	0.0
	4	0.0
	4	0.0

Notes

Hand cleared to 5 feet bls.

Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-2 (0-2).

Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-2 (7-9).

Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-2 (18-20).

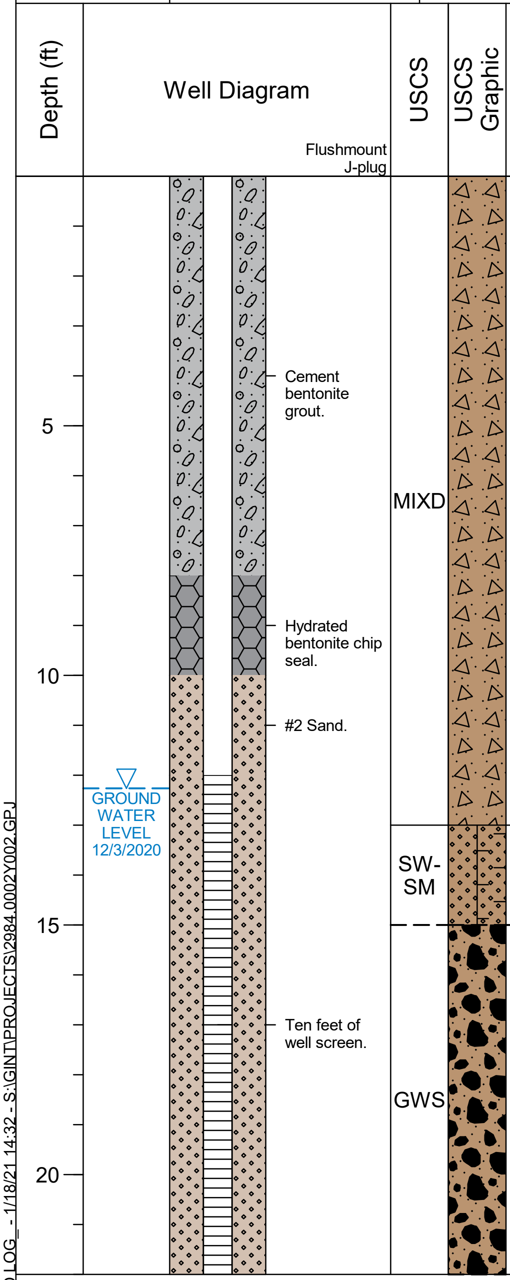
Collect sample for TCL/Part 375+30/TAL full list at SB-2 (20-22).
End of boring at 22 ft bls.

SVA-SB-3/MW-3

Client: SV-A Owners LLC	Site: Sendero Verde - Parcel A	Project Number: 2984.0002Y002
Address: 50 East 112th Street	City/State: New York, New York	Logged By: L. Lai

Start to Finish Date: 11/23/2020 - 11/23/2020	Contractor: AARCO	Drill Type: Geoprobe	Sampler Type/Method: 2" Macro-Core
Borehole Depth: 22 feet	Backfill: Clean cuttings	Borehole Diameter: 2-inches	DTW: 12.26 feet
Area: Block 1617 Lot 120	Elevation: 17.14	Northing: 229650.85	Easting: 999058.78

Well Depth: 22 feet	Well Dia./Materials: 2-inch SCH 40 PVC	Screen Interval: 12-22 feet	Screen Slot Size: 0.02-Slot	Sand/Filter Pack Size: #2	Annular Seal: Bentonite Chips



Depth (ft)	USCS	Visual Description	Sample Interval	Recovery (ft)	PID	Notes
0	MIXD	Brown, fine to coarse SAND, little Silt and Brick (FILL); moist.	G	5	0.0	Hand cleared to 5 feet bls.
5				3	0.1	
10				4	0.0	
13	SW-SM	Brown, fine to coarse SAND, little Silt and Gravel; moist.				
15	GWS	Brown, fine to coarse SAND, little Gravel; wet.		4	0.0	Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-3 (15-17). Collect sample for TCL/Part 375+30/TAL full list at SB-3 (17-19). End of boring at 22 ft bls.

Bottom of borehole at 22 feet

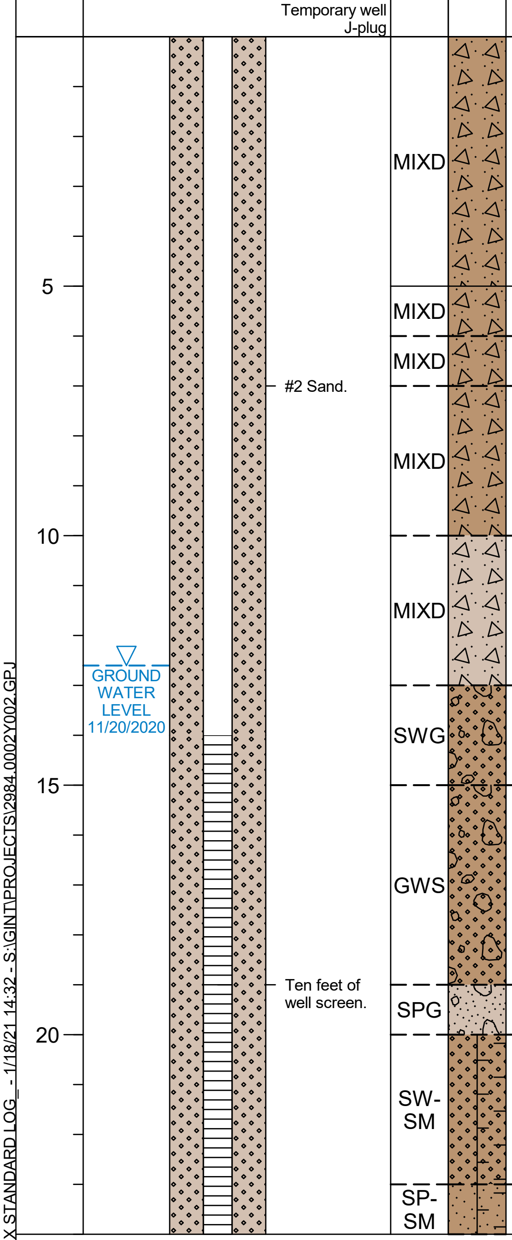
SVA-SB-4/MW-4

Page 1 of 1

Client: SV-A Owners LLC	Site: Sendero Verde - Parcel A	Project Number: 2984.0002Y002
Address: 50 East 112th Street	City/State: New York, New York	Logged By: L. Lai

Start to Finish Date: 11/20/2020 - 11/20/2020	Contractor: AARCO	Drill Type: Geoprobe	Sampler Type/Method: 2" Macro-Core
Borehole Depth: 24 feet	Backfill: Clean cuttings	Borehole Diameter: 2-inches	DTW: 12.6 feet
Area: Block 1617 Lot 120	Elevation: 17.87	Northing: 229737.02	Easting: 999026.23

Well Depth: 24 feet	Well Dia./Materials: 1-inch SCH 40 PVC	Screen Interval: 14-24 feet	Screen Slot Size: 0.02-Slot	Sand/Filter Pack Size: #2	Annular Seal: Bentonite Chips



Depth (ft)	USCS	Visual Description	Recovery (ft)	PID	Notes
	MIXD	Brown, fine to coarse SAND, little Gravel, trace brick (FILL); moist.	5	0.0	Hand cleared to 5 feet bls.
5	MIXD	COBBLE (FILL).	3	0.0	
	MIXD	Brown, fine to coarse SAND, some Brick (FILL); moist.			
	MIXD	Brown, fine to coarse SAND, some Gravel (FILL); moist.			
10	MIXD	Light brown, fine to medium SAND, some Cobble (FILL); moist.	3	5.1	
	SWG	Brown, fine to coarse SAND, little Gravel; moist.		1.4	
15	GWS	Brown, fine to coarse SAND, some Cobble, little Gravel; moist.	4	0.0	
	SPG	Light brown, coarse SAND, some Gravel, little Silt; wet.			Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-4 (18-20).
20	SW-SM	Brown, fine to coarse SAND, little Silt and Gravel; moist.	4	0.0	Collect sample for TCL/Part 375+30/TAL full list at SB-4 (20-22).
	SP-SM	Brown, fine to medium SAND and Silt; wet.			End of boring at 24 ft bls.

Bottom of borehole at 24 feet

SVA-SB-5
Page 1 of 1

Client: SV-A Owners LLC	Site: Sendero Verde - Parcel A		Project Number: 2984.0002Y002
Address: 50 East 112th Street	City/State: New York, New York		Logged By: L. Lai
Start to Finish Date: 11/20/2020 - 11/20/2020	Contractor: AARCO	Drill Type: Geoprobe	Sampler Type/Method: 2" Macro-Core
Borehole Depth: 35 feet	Backfill: Clean cuttings	Borehole Diameter: 2-inches	DTW: 12.0 feet
Area: Block 1617 Lot 120	Elevation: 17.24	Northing: 229670.39	Easting: 999030.79

Depth (ft)	USCS	USCS Graphic	Visual Description	Sample Interval	Recovery (ft)	PID	Notes
	MIXD		Dark brown, fine to medium SAND, some Gravel, trace brick (FILL); moist.	G	5	0.0	Hand cleared to 5 feet bls.
5	SPG		Brown, fine to medium SAND, some Gravel; moist.		3	0.0	
10					3	0.0	
15	SW-SM		Brown, fine to coarse SAND, little Silt; moist.		3	0.0	
20	SP-SM		Reddish brown, fine to medium SAND, some Silt; wet		4	0.0	Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-5 (20-22).
25	SW-SM		Reddish brown, fine to coarse SAND and Silt; wet.		4	0.0	
30					4	0.0	
	SW-SC		Reddish brown, fine to coarse SAND, some Clay; wet.				Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-5 (32-34). End of boring at 35 ft bls.

Bottom of borehole at 35 feet

SVA-SB-6

Client: SV-A Owners LLC		Site: Sendero Verde - Parcel A	Project Number: 2984.0002Y002
Address: 50 East 112th Street		City/State: New York, New York	Logged By: L. Lai
Start to Finish Date: 11/23/2020 - 11/23/2020	Contractor: AARCO	Drill Type: Geoprobe	Sampler Type/Method: 2" Macro-Core
Borehole Depth: 20 feet	Backfill: Clean cuttings	Borehole Diameter: 2-inches	DTW: 12.0 feet
Area: Block 1617 Lot 120	Elevation: 17.56	Northing: 229677.69	Easting: 998999.23

Depth (ft)	USCS	USCS Graphic	Visual Description	Sample Interval	Recovery (ft)	PID	Notes
	MIXD		Brown, fine to coarse SAND, some Gravel, Cobble and Brick (FILL); moist.	G	5	0.5	Hand cleared to 5 feet bls.
5					3	2.2	
	SWG		Light brown, fine to coarse SAND, some Gravel, little Silt; moist.				
10	SW-SM		Brown, fine to coarse SAND, some Silt, little Gravel; moist.		3	0.7	
	SW-SM		Brown, fine SAND, some Silt, little Gravel; moist.			104	Odor.
	SW-SM		Dark grey brown, fine to coarse SAND, some Silt, little Clay; wet.				Collect sample for TCL/Part 375+30/TAL full list PFAS at SB-6 (13-15).
15	SW-SM		Reddish brown, fine to coarse SAND, some Silt, little Gravel; wet.		3	12.1	Collect sample for TCL/Part 375+30/TAL full list PFAS at SB-6 (15-17). Collect sample for TCL/Part 375+30/TAL full list at SB-6 (17-19). End of boring at 20 ft bls.
20			Bottom of borehole at 20 feet				

SVA-SB-7

Client: SV-A Owners LLC	Site: Sendero Verde - Parcel A	Project Number: 2984.0002Y002
Address: 50 East 112th Street	City/State: New York, New York	Logged By: L. Lai

Start to Finish Date: 11/23/2020 - 11/23/2020	Contractor: AARCO	Drill Type: Geoprobe	Sampler Type/Method: 2" Macro-Core
Borehole Depth: 20 feet	Backfill: Clean cuttings	Borehole Diameter: 2-inches	DTW: 12.0 feet
Area: Block 1617 Lot 120	Elevation: 16.71	Northing: 229607.61	Easting: 999022.81

Depth (ft)	USCS	USCS Graphic	Visual Description	Sample Interval	Recovery (ft)	PID	Notes
	MIXD	▨	Brown, fine to coarse SAND, some Silt, little Gravel and Brick (FILL); moist.	G	5	0.2	Hand cleared to 6 feet bls. Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-7 (0-2). Collect sample for TCL/Part 375+30/TAL full list and PFAS at SB-7 (2-4).
5	MIXD	▨	Light brown, fine to coarse SAND, some Gravel, little Silt and Brick (FILL); moist.	⧗	3	0.0	Collect sample for TCL/Part 375+30/TAL full list at SB-7 (4-6).
	SW-SM	▨	Light brown, fine to coarse SAND, some Silt; moist.				
10	SW-SM	▨	Greyish brown, fine to coarse SAND, some Silt; moist.	⧗	3	0.0	
	SW-SM	▨	Reddish brown, fine to coarse SAND, some Silt, little Clay; moist.				
15	ML	▨	Reddish brown, SILT; wet.	⧗	4	0.0	Collect sample for TCL/Part 375+30/TAL full list at SB-7 (15-17). End of boring at 20 ft bls.
20			Bottom of borehole at 20 feet				

APPENDIX D

Excavation Work Plan

APPENDIX D – EXCAVATION WORK PLAN (EWP)

D-1 NOTIFICATION

At least 15 days prior to the start of any activity that is anticipated to encounter remaining contamination, the site owner or their representative will notify the NYSDEC. Table 1 includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of site-related contact information is provided in Appendix B.

Table 1: Notifications*

Andre A. Obligado, NYSDEC Section Chief	Phone: (718) 482-6412 Email: andre.obligado@dec.ny.gov
Steven Wu, NYSDEC Region 2 Project Manager	Phone: (718) 482-6725 Email: steven.wu@dec.ny.gov
Kelly Lewandowski, NYSDEC Site Control Section Chief	Phone: (518) 402-9569 Email: kelly.lewandowski@dec.ny.gov
Mark Sergott, NYSDOH Project Manager	Phone: (518) 473-0771 Email: beei@health.ny.gov

* Note: Notifications are subject to change and will be updated as necessary.

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent of excavation, plans/drawings for site re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control;
- A summary of environmental conditions anticipated to be encountered in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work;
- A summary of the applicable components of this EWP;
- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120;
- A copy of the contractor's health and safety plan (HASP), in electronic format, if it differs from the HASP provided in Appendix E of this SMP;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill, along with all required chemical testing results.

D-2 SOIL SCREENING METHODS

Visual, olfactory and instrument-based (e.g., photoionization detector) soil screening will be performed by a qualified environmental professional during all excavations into known or potentially contaminated material (remaining contamination). Soil screening will be performed when invasive work is done and will include all excavation and invasive work performed during development, such as excavations for foundations and utility work, after issuance of the COC.

Soils will be segregated based on previous environmental data and screening results into material that requires off-site disposal and material that requires testing to determine if the material can be reused on-site as soil beneath a cover or if the material can be used as cover soil. Further discussion of off-site disposal of materials and on-site reuse is provided in Section D-6 and D-7 of this Appendix.

D-3 SOIL STAGING METHODS

Soil stockpiles will be continuously encircled with a berm and/or silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected and damaged tarp covers will be promptly replaced.

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC.

Water will be available onsite at suitable supply and pressure for use in dust control.

D-4 MATERIALS EXCAVATION AND LOAD-OUT

A qualified environmental professional or person under their supervision will oversee all invasive work and the excavation and load-out of all excavated material.

The Volunteer and remedial party (if applicable) and its contractors are responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the site will be investigated by the qualified environmental professional. It will be determined whether a risk or impediment to the planned work under this SMP is posed by utilities or easements on the site.

Loaded vehicles leaving the site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

A truck wash will be operated on-site, as appropriate. The qualified environmental professional or their designated representative will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the site until the activities performed under this section are complete. Truck wash waters will be collected and disposed of off-site in an appropriate manner.

Locations where vehicles enter or exit the site shall be inspected daily for evidence of off-site soil tracking.

The qualified environmental professional or their designated representative will be responsible for ensuring that all egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to site-derived materials.

D-5 MATERIALS TRANSPORT OFF-SITE

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Material transported by trucks exiting the site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

All trucks will be washed prior to leaving the Site.

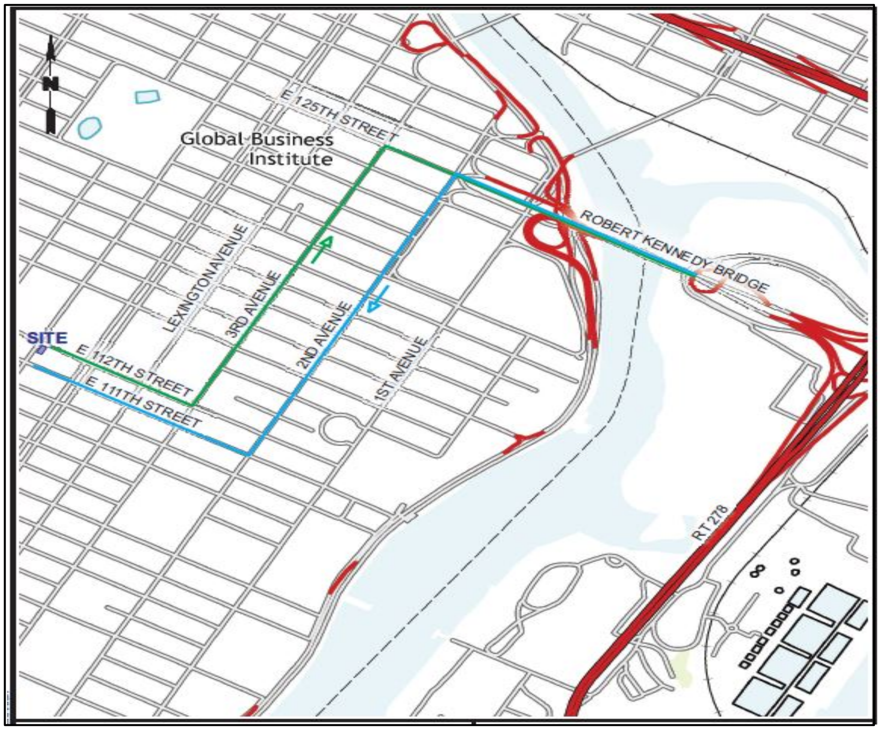
Truck transport routes are as follows:

From Site:

- Head southeast on East 112th Street
- Turn left onto East 125th Street
- Take ramp to Robert F. Kennedy Bridge
- Continue onto Robert F. Kennedy Bridge and exit onto I-278

To Site:

- From I-278 take Robert F. Kennedy Bridge west
- Turn left onto 2nd Avenue
- Turn right onto East 111th Street and proceed to the Site



All trucks loaded with site materials will exit the vicinity of the site using only these approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project site.

Egress points for truck and equipment transport from the site will be kept clean of dirt and other materials during site remediation and development.

Queuing of trucks will be performed on-site in order to minimize off-site disturbance. Off-site queuing will be minimized to the extent practical.

Material transported by trucks exiting the Site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

D-6 MATERIALS DISPOSAL OFF-SITE

All material excavated and removed from the site will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State and Federal regulations. If disposal of material from this site is proposed for unregulated off-site disposal (i.e., clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-site management of materials from this site will not occur without formal NYSDEC approval.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, i.e., hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, C&D debris recovery facility, etc. Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report. This documentation will include: waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled consistent with 6NYCRR Parts 360, 361, 362, 363, 364 and 365. Material that does not meet Unrestricted SCOs is prohibited from being taken to a New York State C&D debris recovery facility (6NYCRR Subpart 361-5 registered or permitted facility).

Soils that are contaminated but non-hazardous and are being removed from the Site are considered by the Division of Materials Management (DMM) in NYSDEC to be C&D materials with contamination not typical of virgin soils. These soils may be sent to a permitted Part 360 landfill. They may be sent to a permitted C&D facility without permit modifications only upon prior notification of NYSDEC Region 2 DMM.

D-7 MATERIALS REUSE ON-SITE

Although not planned, on-site soil may be reused for backfill. The qualified environmental professional will ensure that procedures defined for materials reuse in this SMP are followed and that unacceptable material does not remain on-site. Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for reuse on-site will be placed below the demarcation layer or impervious surface, and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

Any demolition material proposed for reuse on-site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on-site will not be performed without prior NYSDEC approval. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the site will not be reused on-site.

Sampling and analysis of excavated backfill to qualify for unrestricted or restricted residential uses or onsite/offsite reuse will be performed in accordance with the Field Sampling Plan for the Site (Appendix F in this SMP). Representative sampling will be in accordance with DER-10.

D-8 FLUIDS MANAGEMENT

All liquids to be removed from the site, including but not limited to, excavation dewatering, decontamination waters and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge and development fluids will not be recharged back to the land surface or subsurface of the site, and will be managed off-site, unless prior approval is obtained from NYSDEC. Liquids discharged into the New York City sewer system will be addressed through approval by the NYCDEP.

D-9 SITE COVER SYSTEM RESTORATION

After the completion of soil removal and any other invasive activities the cover system will be restored in a manner that complies with the RAWP. The existing Site Cover System is comprised of:

- Concrete building foundation comprised of crushed stone subbase and concrete foundation slab (demarcation layer is the underside of the concrete and waterproofing/vapor barrier).

The demarcation layer, consisting of the underside of the underside of the building slab, will be replaced to provide a visual reference to the top of the remaining contamination zone, the zone that requires adherence to special conditions for disturbance of remaining contaminated soils defined in this SMP. If the type of cover system changes from that which exists prior to the excavation (i.e., a soil cover is replaced by asphalt), this will constitute a modification of the cover element of the remedy and the upper surface of the remaining contamination. A figure showing the modified surface will be included in the subsequent Periodic Review Report and in an updated SMP.

D-10 BACKFILL FROM OFF-SITE SOURCES

All materials proposed for import onto the site will be approved by the qualified environmental professional and will be in compliance with provisions in this SMP prior to receipt at the site. A Request to Import/Reuse Fill or Soil form, which can be found at http://www.dec.ny.gov/regulations/67386.html, will be prepared and submitted to the NYSDEC project manager allowing a minimum of 5 business days for review.

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the site. A pre-determined Beneficial Use Determination (BUD) may be applicable for use of recycled concrete aggregate (RCA) with less than 10 percent passing a number 80 sieve sourced from a NYSDEC registered Construction and Demolition Debris processing facility if used as a substitute for conventional aggregate (i.e., drainage layer beneath pavement or slab). A site-specific BUD may be requested under certain circumstances for soil from environmental remediation sites or other sources or RCA used as backfill for excavations.

All imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Based on an evaluation of the land use, protection of groundwater and protection of ecological resources criteria, the resulting soil quality standards are listed in Table 3. Soils that meet ‘exempt’ fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this site, will not be imported onto the site without prior approval by NYSDEC. Solid waste will not be imported onto the site.

The NYSDEC approved backfill or cover soil quality objectives for the various portions of the site are as follows:

- Track 1 cleanup areas - Unrestricted Use Soil Cleanup Objectives.
- Track 2/4 cleanup areas – lower of the Restricted Residential Soil Cleanup Objectives or the Protection of Groundwater Soil Cleanup Objectives.

Trucks entering the site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

D-11 STORMWATER POLLUTION PREVENTION

Erosion and sediment controls to be installed during future disturbance of residual contamination, if required, will be in conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control. As required, silt fence, barriers and hay bale checks will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the SMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.

D-12 EXCAVATION CONTINGENCY PLAN

During the remedial action, a total of seven underground storage tanks were uncovered and properly cleaned and disposed of offsite by a licensed tank contractor and it is unlikely that there are others present due to the extensive work completed onsite.

In the unlikely event that additional underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition.

Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs and Emerging Contaminants), unless the site history and previous sampling results provide a sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed to the NYSDEC for approval prior to sampling.

Identification of unknown or unexpected contaminated media identified by screening during invasive site work will be promptly communicated by phone to NYSDEC’s Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline. These findings will be also included in the Periodic Review Report.

D-13 COMMUNITY AIR MONITORING PLAN

The CAMP is included within Appendix H of the HASP, which is located in Appendix E of this SMP.

D-14 ODOR CONTROL PLAN

This odor control plan is capable of controlling emissions of nuisance odors off-site and on-site. Specific odor control methods to be used on a routine basis will include limiting open excavation areas and covering excavated soil (i.e., with polyethylene sheeting or covered in roll off containers). If nuisance odors are identified at the site boundary, or if odor complaints are received, 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. NYSDEC and NYSDOH will be notified of all odor events and of any other complaints about the project. Implementation of all odor controls, including the halt of work, is the responsibility of the remedial party’s Remediation Engineer, and any measures that are implemented will be discussed in the Periodic Review Report.

All necessary means will be employed to prevent on- and off-site nuisances. At a minimum, these measures will include: (a) limiting the area of open excavations and size of soil stockpiles; (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) direct load-out of soils to trucks for off-site disposal; (e) use of chemical odorants in spray or misting systems; and (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

D-15 DUST CONTROL PLAN

A dust suppression plan that addresses dust management during invasive on-site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved through the use of a dedicated on-site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

D-16 OTHER NUISANCES

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

A plan will be developed and utilized by the contractor for all remedial work to ensure compliance with NYCDEP noise control ordinances.

APPENDIX E

Health and Safety Plan (including CAMP)

Site-Specific Health and Safety Plan

Sendero Verde Redevelopment Project – Parcel A
Block 1617, Lot 120
New York, New York 10029

July 19, 2022

Prepared for:

SV-A Owners LLC
Sabrina Barker
551 Fifth Avenue, 23rd Floor
New York, New York 10176

Prepared by:

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

2984.0002Y123/CV

Environmental Consulting
& Management
+1.800.322.ROUX
rouxinc.com

Table of Contents

Table of Contents (Continued)

Tables

Figures

Appendices

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.

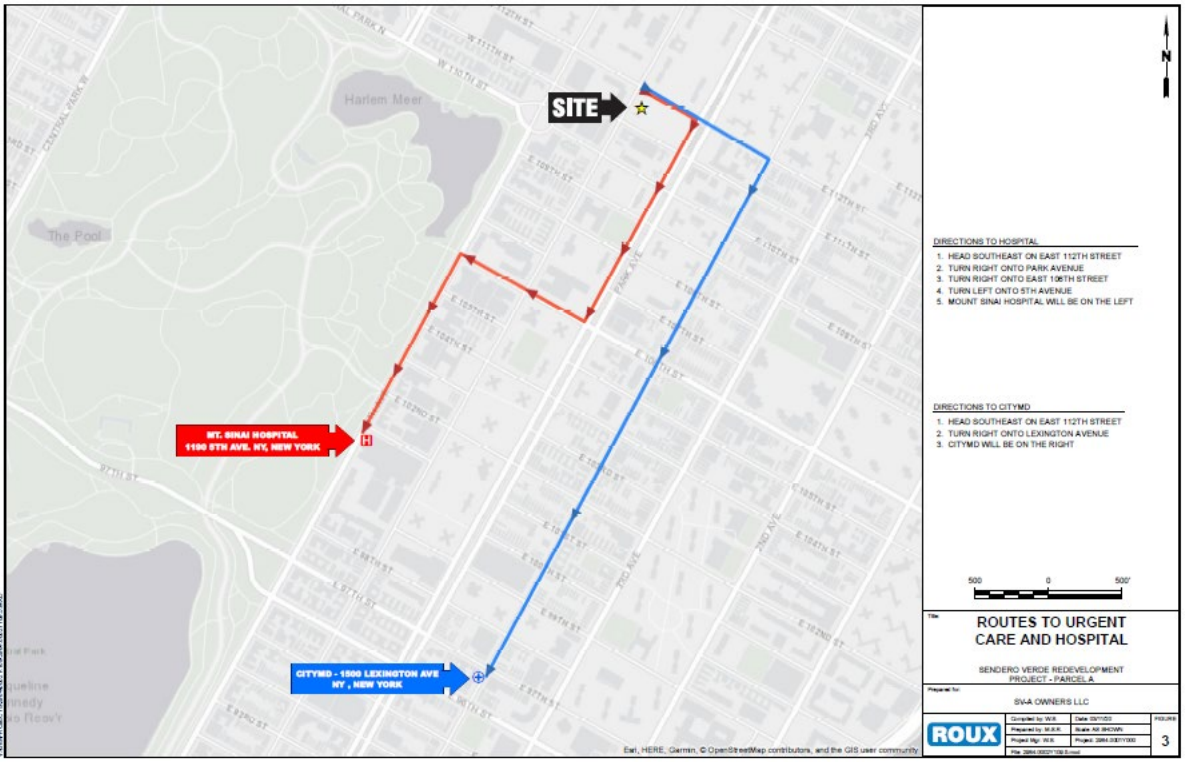
<table>
<tr><th colspan="4">Emergency Contact Information</th></tr>
<tr><th colspan="4">Site Personnel</th></tr>
<tr><th>Title</th><th colspan="2">Contact</th><th>Telephone</th></tr>
<tr><td>Office Manager (OM)</td><td colspan="2">Brain Morrissey</td><td>631-630-2330</td></tr>
<tr><td>Project Principal (PP)</td><td colspan="2">Noelle Clarke</td><td>631-807-6523</td></tr>
<tr><td>Project Manager (PM)</td><td colspan="2">Wendy Shen</td><td>718-913-6240
518-768-1258</td></tr>
<tr><td>Site Supervisor (SS)</td><td colspan="2">Brandon Vella</td><td>631-630-2345</td></tr>
<tr><td>Site Health and Site Safety Officer (SHSO)</td><td colspan="2">Brandon Vella</td><td>631-630-2345</td></tr>
<tr><td>Office Health and Safety Manager (OHSM)</td><td colspan="2">Ron Lombino</td><td>631-630-2372</td></tr>
<tr><td>Corporate Health and Safety Manager (CHSM)</td><td colspan="2">Brian Hobbs</td><td>631-807-0193</td></tr>
<tr><td>AllOne Health</td><td colspan="2">Occupational Health Care Management Provider</td><td>800-350-4511</td></tr>
<tr><td>Client Emergency Contact</td><td colspan="2">Sabrina Barker</td><td>253-632-2204</td></tr>
<tr><th colspan="4">Outside Assistance</th></tr>
<tr><th>Agency</th><th>Contact</th><th>Telephone</th><th>Address/Location</th></tr>
<tr><td>Ambulance/emergency medical services (EMS)</td><td>911</td><td>911</td><td>N/A</td></tr>
<tr><td>Police</td><td>NYPD 23rd Precinct</td><td>212-860-6411</td><td>162 East 102nd Street, New York, NY 10029</td></tr>
<tr><td>Fire</td><td>FDNY Engine 58/Ladder 26</td><td>212-504-4115</td><td>1367 5th Avenue, New York, NY 10029</td></tr>
<tr><td>Site Address</td><td colspan="3">50 East 112th Street, New York, New York 10029</td></tr>
</table>

Route to Mount Sinai Hospital, 1190 Fifth Avenue, New York, NY 10029 (**Figure 3**):

- Head southeast on East 112th Street (144 feet)
- Turn right onto Park Avenue (0.3 miles)
- Turn right onto East 106th Street (0.2 miles)
- Turn left onto 5th Avenue (0.3 miles)
- Mount Sinai Hospital will be on the left

Route to CityMD, 1500 Lexington Avenue, New York, NY 10029 (**Figure 3**):

- Head southeast on East 112th Street (0.1 miles)
- Turn right onto Lexington Avenue (0.8 miles)
- CityMD will be on the right



DIRECTIONS TO HOSPITAL

1. HEAD SOUTHEAST ON EAST 112TH STREET
2. TURN RIGHT ONTO PARK AVENUE
3. TURN RIGHT ONTO EAST 106TH STREET
4. TURN LEFT ONTO 5TH AVENUE
5. MOUNT SINAI HOSPITAL WILL BE ON THE LEFT

DIRECTIONS TO CITYMD

1. HEAD SOUTHEAST ON EAST 112TH STREET
2. TURN RIGHT ONTO LEXINGTON AVENUE
3. CITYMD WILL BE ON THE RIGHT

ROUTES TO URGENT CARE AND HOSPITAL

SENDERO VERDE REDEVELOPMENT PROJECT - PARCEL A

Prepared for:
SV-A OWNERS LLC

Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

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 implementation of the Remedial Action Work Plan (RAWP) at the Sendero Verde Redevelopment Site – Parcel A ("the Site"), located at 50 East 112th Street, New York, NY 10029 (Site; **Figure 1**). These activities fall within the scope of operations covered by 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 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 Manager (CHSM). The PM for this project is Wendy Shen. The Site Supervisor (SS) and Site Health and Safety Officer (SHSO) is Brandon Vella.

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, CHSM, 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.

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 Site Supervisor(s) and others as necessary for safety and health efforts.

Site Supervisor

The Site Supervisor is responsible for field operations and reports to the Project Manager (PM). The Site Supervisor 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 consists Tax Lot 120 in Tax Block 1617 in Harlem, New York. The Site is approximately 14,000 square foot in area and was developed since at least 1896 with several low-rise buildings and the use was mixed residential and commercial. Demolition of the Site buildings began in 1979 and was completed by 1986. The Site is currently vacant and surrounded by a chain link fence. The Site is zoned for residential use with a commercial overlay. Nearby properties include residential and commercial buildings. The proposed future use of the Site includes residential, commercial and community facility spaces.

2.2 Site History

Roux performed a Phase II ESA in April and May 2018, which is described in the Phase II ESA dated June 8, 2018, an Amendment to the Phase II ESA prepared by Roux, dated November 13, 2018; a Waste Characterization Soil Sampling prepared by Roux, dated February 18, 2019; an Interim Remedial Measure Work Plan (IRM) for Underground Storage Tank (UST) Removal in November 2020; and a Supplemental Remedial Investigation (SRI) in November and December 2020, all which are attached in to the Remedial Investigation Report/Remedial Action Work Plan (RIR/RAWP). A summary of the results is provided below.

Summary of Previous Sampling Results (2018, 2019 Roux)

Soil

- The previous investigation reveals the presence of urban fill soils across the Site with metals and SVOCs, specifically PAHs usually associated with such fill material.
- No VOCs, Pesticides or PCBs were detected at a concentration above their respective NYSDEC Part 375 RRSCOs.
- During the Phase II ESA, two SVOCs were detected above their respective RRSCOs:
  - benzo[b]fluoranthene (1,500 µg/kg at SB-9, 0-2 ft bls)
  - indeno(1,2,3-c,d)pyrene (840 µg/kg at SB-9, 0-2 ft bls)
- During the Waste Characterization Soil Sampling, five SVOCs were detected above their respective RRSCOs.
  - benzo[a]anthracene (ranging from 1,300 µg/kg at SB-C3, 0-10 ft bls to 3,200 µg/kg at SB-C1, 0-10 ft bls)
  - benzo[a]pyrene (ranging from 1,200 µg/kg at SB-C3, 0-10 ft bls to 3,300 µg/kg at SB-B, 0-10 ft bls)
  - benzo[b]fluoranthene (ranging from 1,900 µg/kg at SB-C3, 0-10 ft bls to 5,400 µg/kg at SB-B, 0-10 ft bls)
  - dibenzo[a,h]anthracene (ranging from 530 µg/kg at SB-E, 0-10 ft bls to 610 µg/kg at SB-B, 0-10 ft bls)

  - indeno(1,2,3-c,d)pyrene (ranging from 1,000 µg/kg at SB-C3, 0-10 ft bls to 2,800 µg/kg at SB-B, 0-10 ft bls)

- During the Phase II ESA, barium (481 mg/kg at SB-9, 0-2 ft bls), was detected at concentrations above its respective RRSCO.
- During the Waste Characterization Soil Sampling, four metals were detected at concentrations above their respective RRSCOs:
  - arsenic (21 mg/kg at SB-C3 DUP, 0-10 ft bls)
  - barium (ranging from 644 mg/kg at SB-A, 0-15 ft bls to 1,180 mg/kg at SB-B, 0-10 ft bls)
  - lead (ranging from 486 mg/kg at SB-A, 0-15 ft bls to 1,430 mg/kg at SB-E, 0-10 ft bls)
  - mercury (6.8 mg/kg at SB-C3 DUP, 0-10 ft bls)

Groundwater

- One groundwater sample was collected during the Phase II ESA. Only metals exceeded the AWGSGVs. Concentrations of iron (14,600 µg/L), manganese (1,540 µg/L) and sodium (74,000 µg/L), which are naturally occurring, exceeded their AWQSGVs in the unfiltered samples. Sodium also exceeded the AWQSGV in the filtered sample (68,300 µg/L).

Soil Vapor

- One soil vapor sample was collected during the Phase II ESA. The soil vapor sample contained detections of the following VOCs:
  - 2-Hexanone (concentration of 253 micrograms per cubic meter [µg/m^3])
  - Acetone (concentration of 349 µg/m^3)
  - Chloroform (concentration of 44.7 µg/m^3)
  - Methyl Ethyl Ketone (concentration of 1,770 µg/m^3)

UST Removal Activities (2020 Roux)

An Interim Remedial Measure (IRM) Work Plan dated March 16, 2020 was submitted and approved by the NYSDEC on May 20, 2020. The work plan detailed the underground storage tank (UST) removal at the Site. The UST was located immediately adjacent to the property line along 112th Street and approximately 62 feet east of the property line along Madison Avenue. The UST removal was completed on November 16, 2020. The UST measured 3.5 feet wide by 11 feet long containing approximately 1.25 feet of heating oil. A licensed tank contractor, Innovative Recycling Technologies of Lindenhurst, New York completed the tank cleaning and removal.

2.3 Known and Potential Releases of Hazardous Substances at the Site

There are no known releases of hazardous substances at the Site. As indicated in the Phase I Environmental Site Assessment (ESA), past operators of the Site included a bakery, Mohawk Fuel Co., and shoe companies. There is the potential that previous on-Site buildings used fuel oil for heat prior to natural gas conversion. Therefore, there is the potential that fuel oil tanks were present on-Site and undocumented removal of tanks may have occurred or underground storage tanks (USTs) may remain on-Site.

3. Scope of Work

The Remedial Action (RA) scope includes the following:

- Construction oversight of excavation activities;
- Trucking oversight for soil disposal and backfill importation;
- Implementation of Community Air Monitoring; and
- Soil sampling as needed.

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 point identified in **Figure 2**. Access is controlled via a locked gate to be opened by the Site owner's general contractor.

4.3 Buddy System

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 or other difficulties;
- Periodically checking the integrity of partner's PPE; and
- Notifying the Site manager 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

The SOW does not require the implementation of work zones; however, should the need arise, this section provides details for the proper execution of work zones at this Site.

This Site would be 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
- 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 A**. 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 safety data sheets 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.

The information in the JSAs and Safety Data Sheets (SDSs) is made available to all employees and subcontractors who could be affected by an exposure to the hazards covered in them 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 B**.

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) are required 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 CHSM.

5.3 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 **Appendix C**. Government guidance/orders generally consist of implementation of the following protocols/procedures (or some variation thereof):

- Self-monitoring for symptoms;
- Fitness check for work each day;
- Limiting businesses to “essential” operations;
- Social distancing (generally 6 feet);
- Cloth face masks/ coverings;
- Hand washing/ disinfectant use; and
- Care/ awareness of surroundings (public spaces, equipment, hotel rooms, rental cars).

Additional guidance on minimizing potential exposure to SARS-CoV-2, including a JSA, are included in **Appendix C**.

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, AllOne Health (AOH), is initiated. The Injury/Illness Notification Flowchart is provided below and within Roux's Incident Investigation and Reporting program included in **Appendix G**.

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, AOH, immediately following the notifications provided above.

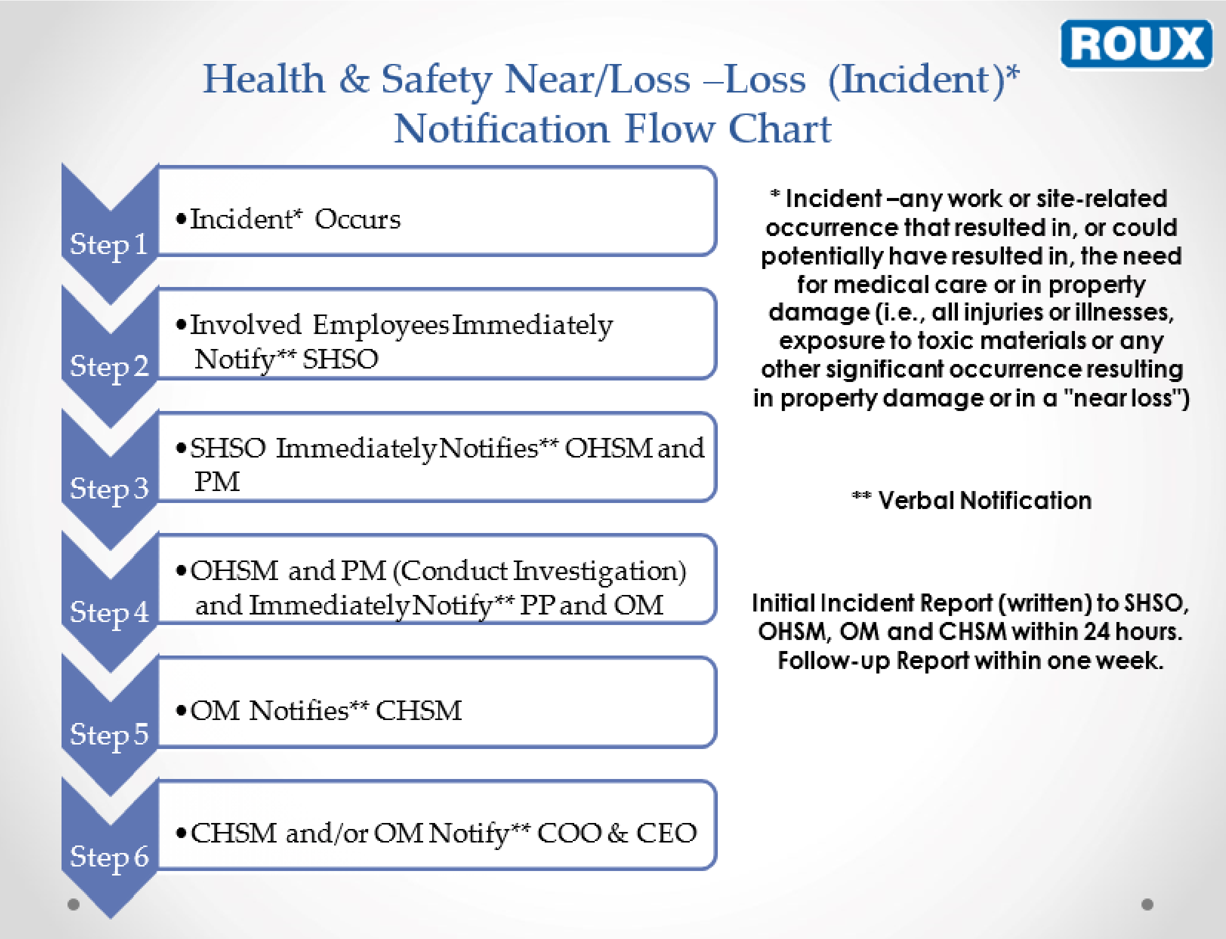
b. Based on discussions with the Project Team, Corporate Management and the AOH evaluation, if medical attention beyond onsite First Aid is warranted, transport the injured / ill person (IP) to the

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 location to CityMD and Mount Sinai 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 Project Manager 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.



ROUX

Health & Safety Near/Loss –Loss (Incident)*
Notification Flow Chart

Step 1 • Incident* Occurs

Step 2 • Involved Employees Immediately Notify** SHSO

Step 3 • SHSO Immediately Notifies** OHSM and PM

Step 4 • OHSM and PM (Conduct Investigation) and Immediately Notify** PP and OM

Step 5 • OM Notifies** CHSM

Step 6 • CHSM and/or OM Notify** COO & CEO

* 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.

6.4 Adverse Weather Conditions

In the event of adverse weather conditions, the SHSO or project principal will determine if work can continue without sacrificing the health and safety of all field workers. Some of the items to be considered prior to determining if work should continue are:

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

- Treacherous weather-related conditions;
- Limited visibility; and
- Electrical storm potential.

Site activities will be limited to daylight hours and acceptable weather conditions. Inclement working conditions include heavy rain, fog, high winds, and lightning. Observe daily weather reports and evacuate if necessary in case of inclement weather conditions.

6.5 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. 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.

7.1 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.

Roux personnel training records are maintained in a corporate database with records available upon request from either the OHSM/SHSO/CHSM or Human Resources Department.

7.2 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.

7.3 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 A**. 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.

7.4 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 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.

7.4.1 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 A** 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.

7.4.2 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.

7.4.3 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.

7.5 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 hazards 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 D**. 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;
- 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 A**, 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.

7.5.1 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 $\geq$ 90 dBA. 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).

7.6 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.

The project falls under applicable NYSDEC requirements which requires additional perimeter air monitoring using CAMP stations.

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 (O_2), carbon monoxide (CO), and hydrogen sulfide (H_2S) sensors shall be used to monitor the potential for oxygen-deficient atmospheres, explosive concentrations of organic vapors, and toxic gases during intrusive operations. Monitoring will be performed according to the action levels for oxygen and combustible gases provided in this section. The calibration for this device will be performed using a known gas composition calibration mixture.
- Two (2) airborne particulate meters at the downwind and upwind locations to monitor for the presence of airborne dust at the site perimeter.

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 CHSM.

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 (e.g., client, board of health, regulators, etc.).

7.6.1 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.

Air Monitoring Summary and Action Levels
Organic Vapors

PID Reading in Breathing Zone (ppm)[1]	Action
0-1 ppm above background[2]	Continue monitoring
1-5 ppm sustained 60 seconds	Continue monitoring; if applicable, initiate additional collection of benzene using colorimetric tubes.
<5 ppm and no presence of benzene	Continue Monitoring, ventilate space
≥ 5 ppm - ≤ 25 ppm and no presence of benzene	Ventilate space until PID reads < 5 ppm. If < 5 ppm cannot be achieved, upgrade to Level C[3].
≥ 25 ppm	Ventilate space and evacuate area.

[1] Based on relative response/sensitivity of PID to benzene.

[2] 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.

[3] 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, Atmospheric Hazard Action Guidelines may be further restricted based on the CHSM's professional judgment and experience.

Air Monitoring Summary and Action Levels Carbon Monoxide	
CO Reading in Breathing Zone (ppm)[1]	**Action**
<25 ppm	Inspect exhaust system for leaks or other sources of CO. Monitor initially and every 15 minutes during use of CO-generating equipment.
25-50 ppm	Ventilate area. Monitor continuously and record measurements. Contact PM.
>50 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 (<2,000 ppm)	Site activities will continue with normal monitoring
4% – 20% LEL (2,000 – 10,000 ppm)	Stop work until levels dissipate to <4% LEL
> 20% LEL (>10,000 ppm)	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
Cannot use air purifying respirators for H_2S because of olfactory fatigue	

7.6.2 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 formaldehyde 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.

7.7 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.

7.8 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 no limited to, chemical/product transfer points and handling.

7.8.1 Initial Spill Notification and Response

Any worker who discovers a hazardous substance spill will immediately notify Wendy Shen, Project Manager or Noelle Clarke, Project Principal. 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.

7.8.2 Spill Evaluation and Response

Noelle Clarke, Project Principal, 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.

7.9 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.

7.9.1 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.

7.9.2 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.

The following items may be used to decontaminate equipment:

- Fresh water rinse;
- Non-phosphorus detergent wash;
- Distilled water rinse; and
- A steam cleaner or pressure washer (heavy equipment only).

7.9.3 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.

7.10 Confined Space Entry

Confined space entry will not be performed at the Site.

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 1910.146.

7.11 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.

7.12 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 CHSM 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.

7.13 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 A**. 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.

7.13.1 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 7.13.3 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. No overhead utilities are present in the vicinity of the work area.

7.13.2 Subsurface Work

Subsurface work activities will require adherence to Roux's Corporate Subsurface Utility Clearance Management program found within **Appendix E**.

7.13.2.1 Excavations and Trenching

All trenching and excavation work activities contracted by Roux shall comply with 29 CFR 1926.651-652 Subpart P. Additionally, for trenches greater than 4 feet deep, where employees will enter, the trench needs to have a stairway or ladder or other safe means of egress. Where employees will enter trenches greater than 5 feet deep, the trench must have some type of protective system or sloped appropriately to prevent cave-ins.

The SHSO will be present on-Site during all Roux contracted excavation and backfill operations and will supplement health and safety monitoring conducted by Subcontractor air quality screening to ensure that appropriate levels of protection and safety procedures are utilized. The proximity of chemical, water, sewer, and electrical lines will be identified by Roux and/or their subcontractor before any subsurface activity or sampling is attempted.

The following safe work practices will be implemented during this task.

- The proximity of chemical, water, sewer, and electrical lines will be identified by a facility representative prior to beginning any subsurface activity.
- While earthmoving, stay out of the excavator's delineated heavy equipment exclusion zone and away from the excavation sides, where there is potential for cave in (within excavations that are 6 feet or more in depth, a delineated perimeter 6 feet away from the excavated edge is required).

Maximum Allowable Slopes

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[3]
Stable Rock	Vertical (90°)
Type A[2]	$^{3}/_{4}$: 1 (53°)
Type B	1 : 1 (45°)
Type C	1 $^{1}/_{2}$: 1 (34°)

OSHA (29 CFR 1926.652, Subpart P, Appendices A and B)

Notes:

[1] Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.

[2] A short-term maximum allowable slope of $^{1}/_{2}$H : 1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 meters) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 meters) in depth shall be $^{3}/_{4}$H : 1V (53°).

[3] Sloping or benching for excavations greater than 20 feet deep shall be designed and stamped by a registered professional engineer.

Proper stockpiling (i.e., 2 feet minimum distance from the excavation edge), containment, transport, storage, and disposal practices will be utilized and is dependent upon the potential type and amount of waste generated during operations. The location of safety equipment and evacuation procedures will be established prior to initiation of operations according to this HASP.

7.13.3 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 F**. Additionally, operation of the drill rig/other heavy equipment will maintain clearances from overhead power lines in accordance with OSHA 29 CFR1926.1408 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

7.14 Heat Stress

The National Oceanic and Atmospheric Administration records average minimum/maximum temperatures of 49/63 degrees Fahrenheit during the year in New York, NY.

7.14.1 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 in hot weather environments. 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.

7.14.2 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.

7.14.3 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 when worn in hot weather environments.

7.15 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. 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: Sendero Verde Redevelopment Project – Parcel A

Name & Company	Signature	Date

9. Approvals

By their signature, the undersigned certify that this HASP is approved and will be utilized at the Sendero Verde Redevelopment Project – Parcel A Site.

.

Brandon D Vella

Brandon Vella – Site Health and Safety Officer

July 19, 2022

Date

Ron Lombino – Office Health and Safety Manager

July 19, 2022

Date

Brian Hobbs, CIH, CSP – Corporate Health and Safety Manager

July 19, 2022

Date

Wendy Sh

Wendy Shen – Project Manager

July 19, 2022

Date

Noelle M. Clarke, P.E. – Project Principal

July 19, 2022

Date

TABLE

Toxicological Properties of Hazardous Substances Present at the Site

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
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	Ca TWA 1 ppm (7 mg/m^3)	TWA 5 ppm (35 mg/m^3)	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 Noncombustible Liquid at ordinary temperatures, but the gas will ignite and burn weakly at 1256°F.
1,1,2-Trichloroethane	79-00-5	TWA 10 ppm	Ca TWA 10 ppm (45 mg/m3) [skin]	TWA 10 ppm (45 mg/m3)	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.
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				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	STEL 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		Ca	[1910.1044] 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.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
1,2-Dibromoethane	106-93-4	None listed	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	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.
1,4-Dioxane	123-91-1	TWA 20 ppm	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	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

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
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	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.
Carbon disulfide	75-15-0	TWA 1 ppm	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	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	TWA 75 ppm	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	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

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
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
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
Ethylbenzene	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
Isopropylbenzene	98-82-8	TWA 1 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
m&p-Xylenes	179601-23-1								
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.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
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	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				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 100 ppm STEL 150 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 (20 ppm) STEL (40 ppm)	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
Sodium Hydroxide	1310-73-2	STEL C 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	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.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
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	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 100 ppm STEL 150 ppm	TWA 100 ppm (435 mg/m^3) ST 150 ppm (655 mg/m^3)	TWA 100 ppm (435 mg/m^3)	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: 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 STEL 10 mg/m^3	TWA 5 mg/m^3 C 15 mg/m^3	TWA 15 mg/m^3 (total dust) TWA 5 mg/m^3 (resp dust)	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
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-Methylnapthalene	91-57-6	TWA 0.5 ppm	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, skin and/or eye contact			Colorless crystalline solid BP: 509 to 527 ° F at 760 mm Hg Fl.Pt. = NA LEL: NA UEL: NA

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Anthracene	120-12-7	None listed	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	50-32-8	None listed	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	218-01-9	None listed	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
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	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

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
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	129-00-0	None listed	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	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	STEL 0.002 mg/m^3 TWA 0.0002 mg/m^3	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.
Cadmium	7440-43-9	TWA 0.01 mg/m^3 TWA 0.002 mg/m^3 (as Cd)	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)	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

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Cobalt	7440-48-4	TWA 0.02 mg/m3	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	7439-89-6	TWA 1 mg/m3	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 0.01 mg/m3 STEL 0.03 mg/m3	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
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

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site.

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
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 [I]	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 TWA 1 mg/m3	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%

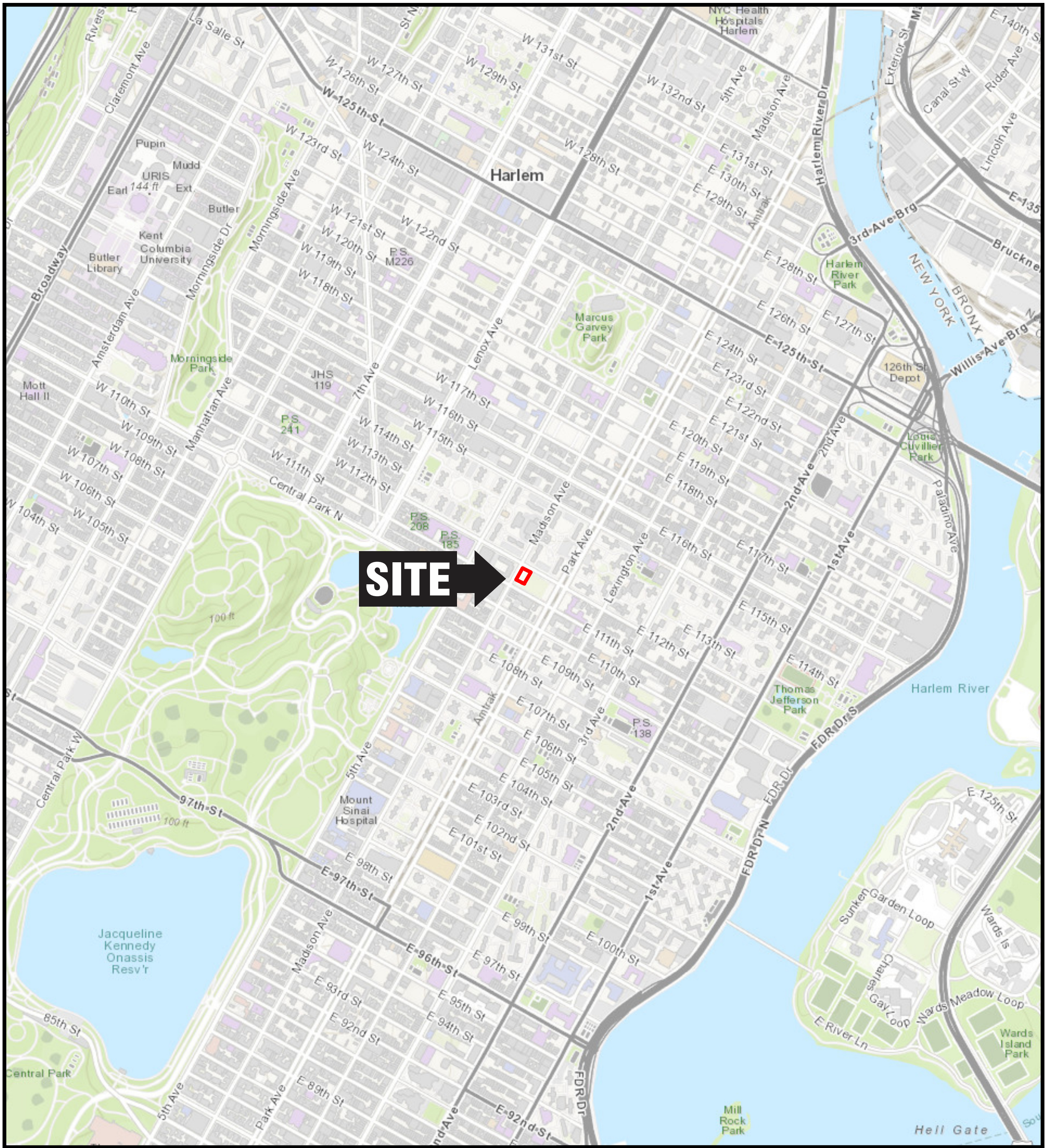
References

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.
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.

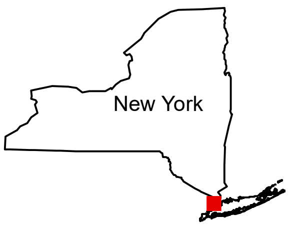
Abbreviations:

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.
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
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
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



N

1,000 0 1,000'

Title:

SITE LOCATION MAP

SENDERO VERDE REDEVELOPMENT
PROJECT - PARCEL A

Prepared for:

SV-A OWNERS LLC

ROUX

Compiled by: W.S.	Date: 12/22/20	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	1
Project Mgr: W.S.	Project: 2984.0002Y000	
File: 2984.0002Y123.1.mxd		

V:\CAD\PROJECTS\LIBRARY\BLOCKS\BORDERS

LEGEND

🟥 SITE BOUNDARY

▨ EMERGENCY MEETING LOCATION

Title:

SITE PLAN WITH EMERGENCY MUSTER AREA

SENDERO VERDE REDEVELOPMENT
PROJECT - PARCEL A

Prepared for:

SV-A OWNERS LLC

ROUX

Compiled by: W.S.	Date: 12/22/20	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	2
Project Mgr: W.S.	Project: 2984.0002Y000	
File: 2984.0002Y123.2.mxd		

V:\GIS\PROJECTS\2984\0002Y123\2984.0002Y123.2.MXD

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

V:\GIS\PROJECTS\2984\0002Y\123\2984.0002Y123.3.MXD

DIRECTIONS TO HOSPITAL

1. HEAD SOUTHEAST ON EAST 112TH STREET
2. TURN RIGHT ONTO PARK AVENUE
3. TURN RIGHT ONTO EAST 106TH STREET
4. TURN LEFT ONTO 5TH AVENUE
5. MOUNT SINAI HOSPITAL WILL BE ON THE LEFT

DIRECTIONS TO CITYMD

1. HEAD SOUTHEAST ON EAST 112TH STREET
2. TURN RIGHT ONTO LEXINGTON AVENUE
3. CITYMD WILL BE ON THE RIGHT

500 0 500'

Title:

ROUTES TO URGENT CARE AND HOSPITAL

SENDERO VERDE REDEVELOPMENT
PROJECT - PARCEL A

Prepared for:

SV-A OWNERS LLC

ROUX

Compiled by: W.S.	Date: 12/22/20	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	3
Project Mgr: W.S.	Project: 2984.0002Y000	
File: 2984.0002Y123.3.mxd		

APPENDICES

A. Job Safety Analysis (JSA) Forms
B. Safety Data Sheets (SDSs) for Chemicals Used
C. COVID-19 Interim Health and Safety Guidance
D. Personal Protective Equipment (PPE) Management Program
E. Subsurface Utility Clearance Management Program
F. Heavy Equipment Exclusion Zone Policy
G. Incident Investigation and Reporting Management Program

APPENDIX A

Job Safety Analysis (JSA) Forms

JOB SAFETY ANALYSIS Ctrl. No. CVD-19	DATE: 04/16/2020	☒ 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	CHSM

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

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. • Use the same vehicle every day and do not share with co-workers. • Verify workers/other people are not approaching vehicle prior to exiting the vehicle. Maintain 6’ of distance from others. • DO not valet your car or allow others to use your car. If necessary, don nitrile gloves and safety glasses and clean/disinfect all high touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (follow manufacturer’s instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. **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 PPE and apply social distancing (6 ft). Use proper donning and doffing procedures for nitrile gloves. 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 disinfect your room upon initial arrival and returning each day. Disinfect all surfaces of your room with an appropriate disinfectant using nitrile gloves. Use proper donning and doffing procedures for nitrile gloves. • 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. Minimize, or avoid entirely, time spent in hotel common areas (i.e., the lobby, dining areas, gyms, etc.). Wash hands or use hand sanitizer often.

---

[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".

3. Tailgate Meeting	**Exposure:** Becoming infected or infecting co-workers	• Must occur outside or remotely (i.e. video or conference call). • Maintain at least a 6+ ft distance between you and others. • Discuss primary infection prevention measures listed below. • Do not require employees or subcontractors to sign in, the Site Supervisor shall record names on the attendance form. • If the Site has more than 10 workers, separate tailgate meetings should be performed. • 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.
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 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. • Do not shake hands or touch others. • Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g. nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically (See Appendix A of Roux Interim H&S Guidance for proper glove removal). • If anyone is coughing or sneezing 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. • Disinfect work surfaces/areas with approved disinfectant you're responsible for (ex: desk, office doorknob, computer, etc.) at least once at the beginning of your shift and at least once at the end of your shift with either sanitizing wipes or disinfectant spray. • Phones should be operated hands free to extent feasible. Sanitize your phone on a regular basis. Disinfection should also take place whenever suspected contaminated material comes in contact with any work surfaces/areas. Wash hands or use hand sanitizer immediately after. • 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. 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% ethanol or 70% isopropanol. 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).
    - Stop handshaking/touching others and use caution when accessing public spaces.
- Clean and disinfect 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.

---

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-001**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Construction – Concrete and Asphalt**	WORK ACTIVITY (Description) **Asphalt Paving**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Richard Starke	Senior Geologist	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 ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Long sleeve high visibility clothing	☒ GLOVES: Cut Restant / Leather / Nitrile / Chemical resistant ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: Hand Tools, Spreader Box, Dump Truck, Asphalt Cement Kettle, Traffic Control (36” cones, flags, caution tape), vehicle chocks, 20-lb. Type ABC Fire Extinguisher

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 (HEEZ) 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. Position dump truck and offload asphalt.	**1a. CONTACT:** With Site traffic and unauthorized personnel.	1a. **Maintain and enforce the EZ**. Equipment being moved into position must have spotters to guide it into position. Never position vehicle with the bed raised.
	1b. CAUGHT: In pinch points of tailgate chutes.	1b. Don leather or Kevlar gloves prior to opening tailgate chutes. Keep hands clear of potential pinch points between tailgate chute and scuttle doors, tailgate, pin latch, etc. Spotter to remain in line of site of driver at all times. If the driver cannot see the spotter, stop immediately.
	1c. FALL: From trip hazards (i.e. rocks, broken asphalt, tools, etc.)	1c. Identify and avoid trip hazards prior to starting work. Remove stones, tools not in use, etc. Equipment not in use to be stored out of the work area.
	1d. CONTACT: With overhead lines and structures.	1d. Identify and avoid overhead hazards prior to raising bed. Maintain EZ between truck/bed and overhead structures.
	1e. EXPOSURE: To hot asphalt.	1e. Do not handle hot asphalt using your hand. Only use hand tools (i.e., shovel, garden hoe, etc.) to handle asphalt. Personnel to stand clear of scuttle doors and maintain EZ. Personnel to stand at side of truck using truck tailgate as barrier and stay out of the line of fire of the asphalt being dumped.
	1f. OVEREXERTION: From opening tailgate chutes.	1f. Use proper body positioning while lifting and opening tailgate (back straight, shoulders square, feet secure on ground).
2. Paving operation with asphalt paving spreader box and/or hand tools.	**2a. EXPOSURE/CONTACT:** To hot asphalt.	2a. Workers will avoid contact with spreader box (if used) and hot asphalt during operation and take breaks to limit exposure to high heat radiating from asphalt mix. Workers will avoid walking on asphalt when not necessary to keep exposure to heat to a minimum. Wear long sleeves and cut-resistant gloves.
	2b. CONTACT: Moving truck back against spreader (if used).	2b. Maintain EZ. Spotters will keep personnel out of path of trucks and keep workers away until truck is backed up against spreader. Workers will not stand between truck and spreader; wear long sleeve high visibility clothing.
	2c. CAUGHT: In pinch points.	2c. Workers will keep hands and limbs away from potential pinch points between truck and spreader (if used).
	2d. OVEREXERTION: Muscle strain.	2d. Workers using rakes and shovels will use correct posture with their back straight and knees bent. Keep load close to body. Loads over 45-lbs. shall be lifted by 2 or more workers or by mechanical means.

---

[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."

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Compacting and sealing new asphalt using a plate compactor or vibratory roller.	**3a. OVEREXERTION:** From handling and using equipment **3b. FALL:** From trip hazards. **3c. EXPOSURE:** To faulty equipment and fuel. **3d. CAUGHT:** In pinch points or between equipment and site structures.	3a. Use proper body positioning while lifting (knees bent, back straight, shoulders square). Loads over 45-lbs. shall be lifted by 2 or more workers or by mechanical means. Take frequent breaks to rest arms and hands or 10-15 minute shifts between 2 operators. 3b. See 1c. above. 3c. Inspect the compactor/roller for proper operation prior to use (i.e., cracked housing, exposed wires, broken handle, etc.). When refueling is necessary verify that the engine is cool prior to fueling. Deploy sorbent pads around compactor to capture any residual fuel; wear chemical resistant gloves while refueling. 3d. Keep hands clear of potential pinch points while operating compactor. Do not stand between compactor/roller and structure. Use of mechanical walk-behind tamper is to be used when within 2’-0” of building or structure so as to limit possible contact with building/structure.
4. Leave work zone.	**4a. EXPOSURE:** To hot asphalt. **4b. CONTACT:** With excess asphalt and debris. **4c. FALL:** To tools and debris.	4a Paving work zone will remain isolated until asphalt is cool enough to open to vehicle and pedestrian traffic. 4b. Work zone will be cleaned up to remove excess asphalt and any debris which could be “spit” out of tires of vehicles. 4c. Tools will be stored in designated areas and debris cleaned up to remove any slip, trip and fall hazards.

---

[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".

JOB SAFETY ANALYSIS **Ctrl. No. GEN-003**	DATE 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Construction - Excavation**	WORK ACTIVITY (Description) **Backfilling Excavation & Compaction**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
David Kaiser	Project Engineer	Brian Hobbs	Corporate Health & Safety Manager
Edward Lacina	Senior Construction Manager		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION ☒ SAFETY TOE BOOTS	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: reflective DOT approved safety	☒ GLOVES: Leather/ cut-resistant level 2 ☐ OTHER _____

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Payloader, Backhoe, Dump Trucks, Mechanical gas powered tampers, Excavator with hydraulic tamper. APR when tamping if dust present. Two-way radios.

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 (HEEZ) 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. Pre-construction meeting: Review proposed excavation locations	**1a. CONTACT:** Potential for contact with subsurface utilities and above ground utilities	1a. Call state 811 for mark out service and one call ticket. 1a. Obtain private utility mark out service as necessary. 1a. Review and mark proposed excavations w/white paint. 1a. Identify all “Critical” zones. A Critical zone is any area within 10 feet of any operating utility. **1a. Complete subsurface clearance checklist.** 1a. Soft dig must be conducted within 2 lateral feet of any suspected underground utility. 1a. Protection of aboveground utilities identified as being located within the work zone must be coordinated w/ client and utility owner.
2. Secure Work Area	**2a. CONTACT:** Potential for personnel to enter the work area. Potential for equipment to contact, or crush personnel. **2b. EXERTION:** Potential for muscle strain or tear while installing traffic cones and barrel	2a. Ensure work area is secure and inform others of work activity. Establish a HEEZ using 42” traffic cones, barrels & snow fencing or telescoping poles. Use of flag persons to maintain clear traffic and to minimize motorist confusion during set-up of new traffic pattern. HEEZ to include tip/swing radius of equipment. 2a. Dump Truck/Excavator/Payloader/Backhoe equipment to be set-up by personnel who are familiar with machinery. Spotters shall be in place for all equipment. and to control access to the HEEZ 2a. Truck wheels are chocked when driver is not in truck and engine shut off. 2a. Personnel shall stay out of the exclusion zone (10’ minimum or greater than the equipment boom) while equipment is maneuvering. 2b. Keep back straight, keep load close to the body and bend knees while lifting and working. If over 50 lbs., use 2 or more laborers for lifting or use of equipment.

---

[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".

3. Backfilling excavation, and compaction	**3a. CONTACT:** Traffic and live equipment. .	3a. Equipment and trucks shall be isolated from other workers, subcontractors and third party traffic with 42" traffic cones, barricades, snow fencing or telescoping poles, and/or Jersey barriers. Spotters shall direct dump truck for placement of fill near excavation. Pay loader/ Excavator, as directed by spotter, shall move fill into trench where it shall be placed in layers and compacted by mechanical means. 3a. Spotters will wear florescent vests at all times. 3a. Spotters will remain out of the exclusion zone, line of fire from equipment and third-party vehicles. 3a. Spotters and operators will have radios for communication, when other visual and/or hand signals are insufficient. 3a. Locate all overhead utilities. All personnel and machinery should maintain a 10' distance from overhead electric lines. Refer to OSHA chart for distances and voltage. 3a. For excavations engineered (shored, sloped, benched} all personnel, equipment, and materials must remain a minimum of 2 feet from edge of excavation.
	3b. EXPOSURE: Fumes from gas powered tamper	3b. Fueling of all equipment will be done outside of work area in a well-ventilated area. Refueling will be done only after a 2-5-minute cool down.
	3c. FALL: Slips, trips, fall hazards.	3c. Work area will be clean and free of any debris to remove slip, trip and fall hazards. All tools will be kept in designated areas. Insure work area is well illuminated. 3c. Workers should only be working in areas that have been leveled with a machine. 3c. All persons working at elevations over 6' shall use a guardrail system or personal fall arrest system while around excavation.
	3d. OVEREXERTION: Muscle strain, or tear.	3d. Keep knees bent and back straight while transferring/ lifting/lowering tamper from elevated areas. Utilize a co-worker to avoid staining muscles. 3d. Keep knees bent and back straight while maneuvering tamper. Utilize a co-worker to avoid staining muscles.
	3e. EXPOSURE: Noise from tamper. Dust inhalation.	3e. Workers will wear hearing protection during compaction tamper activities. 3e. Wear NIOSH approved dust mask for personal comfort. If dust is visible for extended time, limit by wetting down area. 3e. If dust continues stop work and evaluate if APR is needed with approval and clearance.
4. Secure/leave site.	**4a. FALL:** Slip, trip, fall	4a. Clear work area of all debris and store all equipment in designated areas/containers before opening to traffic. 4a. Replace fencing and barricades as needed to secure path before opening roadway or area up to traffic(vehicle, pedestrian and/or bicycle).

---

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-005**	DATE 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Construction**	WORK ACTIVITY (Description) **Cutting with Gas-powered Saw, Sawzall or Plasma Cutter**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Ray Greenidge	Office Health and Safety Manager	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☒ REFLECTIVE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☒ FACE SHIELD (gas powered saw and plasma cutter) ☒ HEARING PROTECTION ☒ SAFETY SHOES: Steel-toed boots	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent Long sleeved shirt and / or reflective safety vest	☒ GLOVES: Cut-resistant, leather, nitrile ☒ OTHER: Chaps for gas powered saw. Welding suit for plasma cutting.

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Sawzall/extension cord

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. Set up/ Secure work area.	**1a. CONTACT:** Personnel could enter the work area	1a. Establish the work zone using 42" cones, caution tape, or fixed rigid barrier. Inform others of work activity.
2. Precutting procedure.	**2a. CONTACT:** Improper blade, malfunctioning guards, unsecured materials, flying debris	2a. Inspect all equipment for defects, replace or service if not functioning optimally. Check that all guards are working and in place, replace if missing. Ensure that blades are sharp and clean to avoid binding and/or burning. Cut on flat/secure work surfaces. Do not cut badly warped wood or boards with knots or nails. 2a. Unplug saw before handing it off to another person. 2a. Wear safety glasses, long-sleeved shirt and leather gloves. Utilize job specific PPE such as welding jacket or chaps when using gas powered saw or a plasma cutter.
	2b. EXPOSURE: Loud noises, dust, bright UV light	2b. When using gas powered saw, wet down area to be cut prior to cutting if high dust levels are anticipated. 2b. Wear hearing protection. Wear a dust mask if large amounts of dust are expected; cut upwind if possible. 2b. When plasma cutting, wear a face shield with shaded glasses rated to block UV light generated by the plasma cutter.
	2c. ENERGY SOURCE: Potential for electric shock	2c. Inspect extension cord for damage. If damaged, tag out and repair / replace. Do not operate saw while standing in water. Ensure GFCI protection at outlet or via attachment. 2c. Ensure all electrical equipment is rated for the task.

---

[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".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Saw Cutting.	**3a. CONTACT:** Fingers could be cut, lacerated or amputated by reciprocating blade; also flying debris and sparks	3a. Cut away from body. Keep fingers away from moving blade. No loose clothing. Never leave saw running unattended. Unplug saw before changing blades or making adjustments / repairs. Set-up barrier to contain sparks. Cut on flat/secure work surfaces. 3a. Wear Safety glasses 3a. Ensure that the saw blade stops rotating/reciprocating before placing saw on the ground.
	3b. CONTACT: Amputation and line of fire injury.	3b. Maintain a minimum 15-foot exclusion zone and ensure that operator and other personnel are kept out of the line-of- fire of the equipment.
	3c. FALL: Tripping hazards caused by cutting/grinding debris, extension cords.	3c. Keep debris generated in designated storage containers. Keep work area free of Slip, Trip and Fall hazards. 3c. Do not route extension cords through walking/working path.
	3d. EXERTION/ERGONOMICS: Lifting heavy or awkward materials may cause muscle strain.	3d. Maintain Proper Body Position while operating lifting and moving with equipment. Keep load close to body, knees bent, and back straight. 3d. Take frequent breaks or switch personnel if cutting for an extended period of time.
	3e. EXPOSURE: Personnel may be exposed to fire hazard during Hot Work Activities.	3e. Complete Hot Work Permit, Designate Fire Watch. 3e. Conduct work zone inspection: – Verify that all combustible or flammable materials or equipment fuel sources have been removed from within 35 feet of the proposed hot work. – If combustible or flammable materials or equipment fuel sources have not been removed from within 35 feet of the hot work, verify that engineering and procedural controls have been emplaced: curtains, blankets, wetting, ventilation. 3e. Two 20-lb. Type ABC Fire extinguishers required. 3e. Conduct continuous air monitoring / Lower Explosive Limit (LEL) screenings. Action Level: 10% of the LEL. 3e. If ambient air concentrations exceed LEL Action Levels, STOP WORK and contact supervisor. 3e. Wear hard hat, long sleeved-shirt and safety glasses. Utilize job specific PPE such as welding jacket or chaps and welding glasses when using gas powered saw or a plasma cutter.
4. Secure area when leaving tools unattended.	**4a. CONTACT:** Unauthorized personnel may enter the work area	4a. Unplug saw when not being used. Store equipment in designated storage areas when not being used.
	4b. FALL: Slip/trip/fall	4b. Store tool in designated storage location when it is not being used, secure all extension cords, keep all equipment out of walkways. 4b. Keep work area free of Slip, Trip and Fall Hazards.

---

[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".

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 **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL 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.

---

[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".

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	3c. Contain drill cuttings and drilling water to prevent fall hazards from developing in work area. 3c. See 1b.
	3b. EXPOSURE: Noise and dust.	
	3c. FALL: Slip/trip/fall hazards.	
	3d. CAUGHT: Limb/extremity pinching; abrasion/crushing.	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. CONTACT: Equipment imbalance during advancement of drill equipment.	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. EXPOSURE: Inhalation of contamination/vapors.	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. EXERTION: Potential for muscle strain/injury while lifting and installing well casings, lifting sand bags, and/or lifting rods.	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.	4a Utilize team lifting for objects over 50lbs. 4a. Use hydraulic liner extruder if available.
	4b. CONTACT: Pinch points and cuts	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. EXPOSURE: Inhalation and/or dermal contact with contaminants.	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).	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. EXPOSURE: To chemicals in cleaning solution including ammonia.	5b. See 4a. Review SDS to ensure appropriate precautions are taken and understood.

---

[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".

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

---

[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".

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	2a. Open and close doors slowly. Never put hands or feet in between door and vehicle to avoid pinch points.
	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	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. 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.	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)

---

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-009**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 1

JSA TYPE CATEGORY **Generic**	WORK TYPE **O&M**	WORK ACTIVITY (Description) **Movement of 55-Gallon Drums/Drum Handling with Mobile Carrier**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Michael Sarni	Technician	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
☒ 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: Cut-resistant gloves
☐ OTHER:

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Mobile Drum Carrier, safety cones, and caution tape

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 (i.e. forklift) 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. Preparing for and Inspection of Drum	**1a. FALL:** Tripping/falling due to uneven surface. Loose debris/garbage in work area.	1a. Clear area of loose garbage and debris. Inspect 55-gal drums for proper condition, labeling, check drum ring and bolts for tightness, inspect mobile drum carrier. 1a. Do a Test Lift to get a general sense of the weight of the drum. 1a. Inspect and use established pathways to avoid uneven terrain, weather-related hazards (i.e., debris, puddles, ice, etc.), and other obstructions. 1a. Secure work area and coordinate and communicate the planned work activities with other personnel working in the area. 1a. Delineate work area with 42” safety cones.
	1b. CONTACT/EXPOSURE: Drums could potentially be damaged or contain hazardous material. Mobile drum carrier could potentially be in poor working condition causing malfunctioning during operation.	1b. Prior to inspecting drums don cut-resistant gloves. If drum is not properly labeled, do not open and cease all drum transport activities. Immediately contact project manager and inform him/her of drum situation. 1b. Do not continue drum transport activities until further actions are determined by the project manager. 1b. If the drum is properly labeled, but leaking, improperly sealed or in poor condition, place drum in an over-pack drum. 1b. Inspect mobile drum carrier to ensure its overall integrity. Look for rust marks or potential weak points where the drum carrier could malfunction. Inspect the wheels to ensure that they easily turn and nothing is impeding their movement.
	1c. EXERTION/CAUGHT: Potential pinching/exertion hazards while securing ring/ tightening bolts	1c. Keep back straight and knees slightly bent while securing drum ring/tightening bolt. Wear cut-resistant gloves.

---

[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."

2. Position drum clamp tightly in between drum ribs, securing drum clamp to drum with chain	**2a. CAUGHT:** Pinching fingers between drum clamp and handle/chain.	2a. Attach drum clamp with chain and tighten until snug. Do not place hands between drum clamp and drum as the chain is tightened; wear cut resistant gloves. Keep face away from drum when handling in case of escaping vapors.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
3. Disengage safety latches on handle, pull handle down until drum is lifted off ground and safety latches are reengaged; slightly suspending drum off the ground	**3a. EXERTION/ CONTACT:** Potential muscle strain associated with lifting/engaging drum/handle. Drum could shift/slip downward and crush toes.	3a. Ascertain whether the drum is overweight; if it is, then two people are needed to lower handle while drum is secured with clamp so that safety latches can be engaged. Keep body out of the line of fire of the handle (do not position head above handle) as it is being pushed down. Do not allow feet/toes to be positioned under the drum as it is being lifted; wear steel/composite toe boots.
	3b. CAUGHT: Fingers could be pinched while engaging/disengaging safety latches on handle	3b. Wear cut-resistant gloves while disengaging/reengaging safety latches. 3b. Avoid placing hands in pinch points.
4. Transport drums to designated location and disengage drum clamp (repeat Step 3 in reverse order)	**4a. FALL:** Tripping/ falling due to obstructions and uneven terrain. Potential for drum to fall during transport.	4a. Ensure transport path is free of potential obstructions that may cause the drum/carrier to become unstable. Position drum clamp between the ribs on the drum to prevent possible slipping.

---

[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."

JOB SAFETY ANALYSIS **Ctrl. No. GEN-010**	DATE 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Surveying**	WORK ACTIVITY (Description) **Elevation Surveying**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Mark M Emmons	Project Engineer	Brian Hobbs	Corporate Health & Safety Manager
Bjorn Wespestad	Senior Engineer		
William Hansen	Senior Engineer		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES: Steel-toe boots	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing	☒ GLOVES: Cut-resistant or leather ☒ OTHER: Long sleeve Shirt

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Surveying equipment (i.e., leveling rod/measuring ruler, tripod and autolevel).

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. Check in with Site manager/ property owner.	**1a. CONTACT/EXPOSURE/FALL:** Lack of communication could result in H&S incident.	1a. Inform Site personnel of work scope, timeline and location(s). 1a. Inquire about other activities taking place at the Site. 1a. If applicable, obtain General Work permit for the day.
2. Locate surveying position for instrument and rod and set-up work area	**2a. FALL:** Slip/trip hazards	2a. Inspect area for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.) and obstructions prior to setting up at the survey location. Keep eyes engaged with walking surface while in movement. Remember “Walking is Working.” 2a. Conduct housekeeping and maintain clear paths to walk in and remove debris as required.
	2b. CONTACT: Traffic (surveying locations could potentially be in parking areas and sidewalks)	2b. Be aware of oncoming traffic. Utilize a flagman / spotter for locations in streets or high-traffic areas. 2b. Place 42 inch cones around the work area and delineate work zone with caution tape, snow fencing or safety bars, if necessary. 2b. Wear appropriate PPE including long sleeve high visibility clothing and or reflective safety vest. 2b. Face traffic, maintain eye contact with oncoming vehicles and establish a safe exit route.
	2c. OVEREXERTION: Hazard due to carrying, lifting, and bending while transporting equipment	2c. Use proper body positioning and lifting techniques; keep back straight, lift with legs, keep load close to body, and never reach with a load. 2c. Avoid carrying too much equipment at one time and team-lift equipment that is more than 50 lb.
	2d. CAUGHT/CONTACT: Pinch Points / sharp edges associated with setting up the tripod	2d. Wear cut resistant gloves when handling the tripod and keep fingers away from pinch points located near moving parts of the tripod. Don’t carry tripod by the pointed ends.
	2e. OVEREXERTION: Hazard due to bending awkwardly to look through the autolevel	2e. When practical, set the height of the autolevel optic as to minimize bending at the waist.

---

[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".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Open / close manhole cover to well that is being surveyed (if necessary).	**3a. OVEREXERTION:** Muscle strain	3a. See 1c. Bend knees when reaching to open well. Use manhole lifting hook or pry bar to avoid bending.
	3b. CAUGHT: Pinch points associated with removing / replacing manholes and working with hand tools	3b. Wear leather gloves or cut resistant gloves when working with well cover and hand tools. 3b. Use proper tools (ratchet and crowbar or pry bar for well cover) and inspect before use. 3b. Do not put fingers under well cover.
	3c. EXPOSURE: To potentially hazardous vapors To biological hazards	3c. No open flames/heat sources. 3c. To minimize exposure to vapors, allow well to vent after opening it and before survey activities begin. 3c. Work on the upwind side of manhole/well. 3.c Use caution while opening lids to inspect work area for bees and insects inside of covers. 3c. Use insect/tick repellent as necessary.
	3d. CONTACT: With traffic	3d. See 2b.
4. Perform survey.	**4a. FALL:** Slip/trip hazards	4a. See 2a.
	4b. CONTACT: Traffic (surveying locations could be potentially located in parking areas and sidewalks)	4b. See 2b. 4b. Personnel using the scope will be devoting most of their attention to the surveying activity and shall be aware of vehicular and pedestrian traffic. Personnel holding the measuring stick should be extra vigilant of survey personnel and communicate any potential hazards to the instrument person via handheld radio or similar means. Ensure reflective safety vest is worn.
	4c. ENERGY SOURCES: Electrical shock from survey rod striking overhead electric lines or lights	4c. Prior to raising and extending the survey rod, personnel should thoroughly inspect the area above the measuring point. If overhead electrical lines are encountered within 20 feet of the measuring point; stop work and consult with the office health and safety officer.
5. Break down work area.	**5a. CONTACT:** Traffic (surveying locations can potentially be in parking areas and sidewalks)	5a. See 2b.
	5b. EXERTION: Hazard due to carrying, lifting, and bending while transporting equipment	5b. See 2c.
	5c. CONTACT: Personal injury or equipment damage by striking surroundings with an extended rod or unsecured tripod leg	5c. Ensure rod is entirely collapsed prior to mobilization / demobilization between survey points. 5c. Ensure tripod legs are fully collapsed and secured with strap prior to mobilization / demobilization between set-ups.

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-011**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY	WORK TYPE	WORK ACTIVITY (Description)	
Generic	**Construction - Excavation**	**Excavation / Trenching**	
DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
David Kaiser	Senior Engineer	Brian Hobbs	Corporate Health & Safety Manager
Ian Holst	Senior Engineer		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST
☒ HARD HAT
☒ LONG SLEEVED SHIRT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES
☐ GOGGLES
☐ FACE SHIELD
☒ HEARING PROTECTION
☒ SAFETY SHOES: Steel-toe boots
☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective vest or high visibility long sleeved clothing
☒ GLOVES: Leather or cut resistant
☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Jackhammer, Excavator, Backhoe, Hand Tools, Photoionization Detector, barrels, 42” traffic cones, snow fencing, telescoping poles, temporary chain link fence, ladders, shovels, digging bars, power tools (cut-off saw), Two-way radios, Sheeting, Trench box, Retractable lanyard, Harness

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 footprint of a structure to be demolished.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Pre-Clearance Protocol.	**1a. CONTACT:** Damage to underground utility.	1a. Confirm that (if applicable) “Call Before You Dig” and local utility companies were contacted prior to trenching in order to confirm utility mark outs. Must have a case # before digging.
	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 the trenching 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) prior to trenching. Supervisor should be contacted to discuss appropriate pre-clearing depth. **1b. Complete subsurface clearance checklist**.
	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. Set up work zone.	**2a. CONTACT/CAUGHT:** Cuts/lacerations from equipment. Broken bones from contact by vehicle.	2a. Isolate work area from hazards with cones, barricades, and snow fencing, telescoping poles or temporary chain link fence. Utilize a flag person when necessary (i.e., third party traffic in area). Install traffic signs in roadways and for detours. Spotters will maintain and enforce exclusion zone.
	2b. FALL: Slip, Trip or Fall may cause muscle strains or tears, abrasions, lacerations, or broken bones.	2b. See 1c.

---

[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".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Trenching Activity.	**3a. CONTACT:** Serious injury including broken bones, muscle strains or tears, and possibly death due to contact with machine.	3a. Spotter(s) required for all heavy equipment operation. No worker shall be allowed inside the exclusion zone or along the trench/excavation area while any equipment is in operation. A minimum exclusion zone greater than the length of the equipment boom must be established. Workers only allowed in exclusion zone if the operator is in “Hands Off “mode. Operator will not operate equipment until worker is out of exclusion zone. Spotters and operators will have radios for communication, when either loses sight of one another, and/or in case of emergency.
	3b. FALL: Slip, Trip or Fall may cause muscle strains or tears, abrasions, lacerations, or broken bones	3b. Any trench/excavation deeper than 3’ must have a ladder within 25’ of any worker in the excavation. At least 3‘(rungs) of the ladder shall be above the top of the excavation. All spoil piles shall be maintained 2’ minimum from edge of excavation. 3b. Any trench/excavation deeper than 6’ must have fall protection, retractable lanyard for ladder use, and 42” high guardrails along the edge of the trench/excavation.
	3c. EXPOSURE: Noise, Dust, Concrete- Asphalt, petroleum hydrocarbon vapors may cause damage to ears and lungs	3c. Air monitoring using a calibrated photoionization detector (PID) will be used to monitor the breathing zone of the work area. If a reading of >5ppm is recorded, the oversight personnel must temporarily cease work and instruct all Site personnel to step away from the area of elevated readings.
4. Setting Trench protections if necessary.	**4a. CAUGHT:** Injury due to contact with failed trench, may include muscle strains or tears, abrasions or lacerations, broken bones and possibly death.	4a. To prevent cave-ins and avoid caught by/between, excavations over 4’ in depth, unless working in stable rock, shall have engineer approved shoring, sheeting or trench box. Top of protection shall be at least 2’ above top of excavation.
	4b. CONTACT/CAUGHT: Injury due to rigging activities and entering exclusion zone during lifting and/or transport of shoring/trench box/material may include muscle strains or tears, abrasions or lacerations, broken bones and possibly death.	4b. Use only inspected rigging with 2, 3 or 4 lift points; wear cut-resistant gloves. Rigging to be hooked up to factory installed hook up points on equipment. Control load with non-conductive tag lines with workers out of exclusion zone. Don’t stand underneath suspended load; wear steel toed boots and hard hat.
	4c. FALL: Possible injury due to fall into excavation may include muscle strains or tears, abrasions or lacerations, or broken bones.	4c. Shoring to be set and sides will be backfilled to avoid fall hazards before workers are allowed to enter area. Operator will be in “HANDS OFF” mode before workers enter work area to unhook rigging. An inspected ladder extending 3’ above top of the shoring will be used to enter and exit the shoring. Workers will use three points of contact when using the ladder.
5. Secure/Leave Site. If backfilling, see excavation backfilling and compaction JSA for potential hazards and critical actions.	**5a. FALL:** Potential Slip, Trip or Fall - may cause muscle strains or tears, abrasions or lacerations, or broken bones.	5a. See 1c. 5a. All open excavations must be backfilled or secured prior to departure with steel plates, orange construction fence or temporary chain link fencing.

---

[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".

JOB SAFETY ANALYSIS Ctrl. No. GEN-013	DATE 7/10/2020	☐ 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	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.

[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
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.

---

[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".

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 [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL 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.

---

[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."

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.

[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."

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-015**	DATE: 7/10/2020	☐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	Corporate Health & Safety Manager
Tally Sodre	OHSM		

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.

---

[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."

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).

---

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-017**	DATE: 7/10/2020	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **GENERIC**	WORK TYPE: **Drilling**	WORK ACTIVITY (Description): **Monitoring and Recovery Well Development**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Ron Lombino	Project Geologist	Brian Hobbs	Corporate Health & Safety Manager
Courtney Lind	Project Engineer		

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	☒ GLOVES: Leather or cut-resistant and Nitrile ☒ OTHER: Insect repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment as needed: Truck Rig or support truck, Trailer, 42-inch Safety cones and flags, Caution Tape, Interface Probe, Power Source, Submersible Pump, Surge Block/Plunger, 20 lb. Type ABC Fire Extinguisher, Holding Tanks and/or Buckets, Absorbent Pads, 5-gas meter, Tools as needed: Socket and Pipe Wrench, Screw Driver, Pry Bar, Ratchet, Vault Key.

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 **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Mobilization / Demobilization (**Review Mobilization and Demobilization JSA**)	**1a. CONTACT:** Equipment/property damage.	1a. The truck rig's tower/derrick will be lowered and secured prior to mobilization. 1a. Set-up the work area / position equipment in a manner that eliminates or reduces the need for backing of trucks and trailers. 1a. All non-essential personnel should **maintain an exclusion zone greater than the swing/tip radius of equipment.** 1a. Beep horn twice before backing up. 1a. When backing up with an attached trailer use a spotter Level or avoid if needed.
	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. Store equipment at lowest potential energy.
2. Open/close well.	**2a. EXERTION:** Muscle strain (some wells have large vault covers).	2a. Keep back straight, lift with legs, keep load close to body, and never reach with a load. Ensure that loads are balanced to reduce the potential for muscle strain. Two people are required when lifting objects over 50 lbs or when the shape makes the object difficult to lift.
	2b. CAUGHT: Pinch points associated with removing/replacing manholes and working with hand tools.	2b. Wear cut-resistant/leather gloves when working with well vault/cover and hand tools. Do not put fingers under well vault/cover. 2b. Use ratchet and pry bar for well cover and inspect before use.
	2c. EXPOSURE: Potentially hazardous vapors.	2c. No open flames/heat sources. 2c. Allow well to vent after opening it and before starting development activities to minimize exposure to vapors. Air monitoring must be performed prior to set up and during the well development activities. Work on upwind side of well.
	2d. CONTACT: Traffic.	2d. Wear required PPE including high visibility clothing or reflective vest. 2d. Delineate work area with 42" safety cones and/or other barriers. Position vehicle to protect against oncoming traffic. 2d. Face traffic, maintain eye contact with oncoming vehicles, and establish a safe exit route.

---

[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, torque.

[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. Develop well (mechanical surging).	**3a. CAUGHT:** Cut hazards and finger pinch points.	3a See 2b. 3a. Use required PPE including leather/cut-resistant gloves when handling development equipment. Identify finger/hand pinch points. Keep hands away from active surge equipment. 3a. All non-essential personnel should **maintain an exclusion zone greater than the swing/tip radius of equipment.**
	3b. CONTACT/EXPOSURE: Contamination (e.g., SPH, contaminated groundwater, vapors).	3b. See 2c. 3b. Wear Nitrile gloves and safety glasses. Insert and remove surge block/plunger and line/cable slowly to avoid splashing at the surface. 3b. Use an absorbent pad to clean any spills.
	3c. EXERTION: Muscle strain from lifting equipment.	3c. See 2a. 3c. Use mechanical device to insert and remove surge block/plunger if greater than 50lb.
	3d. CONTACT: Injury while handling wench line/cable, or with active surging equipment.	3d. If using a drill rig, inspect all wench lines/cables for any kinks or if frayed prior to use. Replace any damaged lines/cables. Review **Drill Rig checklist prior to development activities**. 3d. See 3a.
4. Purging well (pumping water to holding tanks/drums/buckets).	**4a. CAUGHT:** Pinch points associated with connecting hose to tank. Pinch points associated with handling pump and hoses.	4a. See 3a. 4a. Ensure that fingers are not placed near coupling when attaching and securing hose(s). Do not place fingers under pump/hoses. Wear leather or cut-resistant gloves when handling pump/hose(s). 4a. Keep hands clear from any line of fire.
	4b. FALL: Using side mounted ladder when attaching hose to tank. Slip, trip, fall from lines/hoses	4b. Inspect ladder steps to make sure steps are not bent/damaged and free of debris/fluid. 4b. Use three points of contact always when using ladder. 4b. Use hoist or other mechanical means to secure and move hose. 4b. Utilize anti-whip cords on all compressed hoses. Keep hoses and lines coiled and organized out of designated walking paths around the work zone.
	4c. CONTACT: Contamination (e.g., SPH, contaminated groundwater).	4c. Secure water hose. 4c. Do not overfill tanks, and purge/transfer liquids in such a manner that they do not splash. (See 3b). 4c. Dispose of used materials/PPE in the designated impacted PPE container.
	4d. EXERTION: Muscle strain from lifting/carrying equipment.	4d. See 2a.
	4e. FALL: Spilled purge water.	4e. Clean up any spills using absorbent pads or spill kits.
5. Decontaminate equipment	**5a. CONTACT/EXPOSURE:** Contamination (e.g., SPH, contaminated groundwater, vapors).	5a. See 3b.
	5b. EXPOSURE/CONTACT: Chemicals in cleaning solution	5b. Decontaminate equipment in well-ventilated area. Wear nitrile gloves to avoid skin contact with cleaning solutions.

---

[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, torque.

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-019**	DATE: 7/10/2020	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Site Walk and Inspection**	
DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Sara Barrientos	Staff Geologist	Brian Hobbs	Corporate Health and Safety Manager
		Joe Duminuco	Vice President

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.

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 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 mechanical assistance or 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. • Protect exposed skin with insect repellent.

---

[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".

	2e. EXPOSURE: Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	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. 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 **3b. OVEREXERTION:** Personal injury from lifting/moving/rotating equipment. **3c. EXPOSURE:** Hearing damage from noise generating equipment/processes. Inhalation/exposure to hazardous vapors and or dust. **3d. EXPOSURE:** Working in a remote area.	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. See 2c. 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. 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 (i.e., cell phone, walkie-talkie) or directional (i.e., map, compass, etc.) device when traversing remote areas.
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.

---

[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".

JOB SAFETYANALYSIS **Ctrl. No. GEN-020**	DATE: 7/10/2020	☐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	Corporate Health and Safety 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 ¹JOB STEPS	Analyze ²POTENTIAL HAZARDS	Act ³CRITICAL 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. 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.

---

[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, contraction/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
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.

---

[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".

JOB SAFETY ANALYSIS **Ctrl. No. GEN-021**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **GENERIC**	WORK TYPE **Gauging and Sampling**	WORK ACTIVITY (Description) **Soil Vapor Sampling (Permanent Monitoring Points)**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Jeff Wills	Senior Hydrogeologist	Brian Hobbs	Corporate Health and Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST	☐ GOGGLES	☐ AIR PURIFYING RESPIRATOR	☒ GLOVES: Cut-resistant & Nitriles
☒ HARD HAT	☐ FACE SHIELD	☐ SUPPLIED RESPIRATOR	☒ OTHER: Bug Spray, Sun Screen, Knee Pads or kneeling pad
☐ LIFELINE / BODY HARNESS	☐ HEARING PROTECTION	☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing	
☒ SAFETY GLASSES	☒ SAFETY SHOES: Steel-toe boots		

REQUIRED AND / OR RECOMMENDED EQUIPMENT

9/16” Socket and Wrench, Non-Toxic Clay, Teflon-Lined Tubing, Masterflex Tubing, Air Pump with Low Flow, Dry Cal, Enclosure (Bucket with 2 holes), Helium Gas Canister, Summa Canisters and Flow Controllers, MultiRae Photo Ionization Detector (PID), Helium Detector, Tubing Cutter, 42-inch Safety Cones, Caution Tape or Retractable Cone Bars

COMMITMENT TO SAFETY- All personnel onsite will actively participate in hazard recognition and mitigation throughout the day by verbalizing SPSAs.

Work Zone (WZ): A 5-foot exclusion zone will be maintained for non-essential personnel.

Assess [1]**JOB STEPS**	**Analyze** [2]**POTENTIAL HAZARDS**	**Act** [3]**CRITICAL ACTIONS**
1. Define and secure work area.	**1a. FALL:** Potential tripping hazards. **1b. CONTACT:** Potential contact with moving vehicles or pedestrians. **1c. EXERTION:** Muscle strain while lifting and carrying equipment.	1a. Ensure work area is secure and inform others (third party) of work activity. 1a. Remove tripping hazards and inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 1b. If working alongside roads, look both ways before entering roadways, face traffic, and utilize work vehicle to protect employees. 1b. Delineate work area (including vehicles) with traffic safety cones and caution tape or retractable cone bars. 1b. Maintain a 5-foot work zone. 1b. Wear high visibility clothing or reflective safety vest. 1c. When carrying equipment to/from work area, keep back straight, lift with legs, keep load close to body, never reach with a load. Ensure that loads are balanced. Use mechanical assistance/make multiple trips to carry equipment.
2. Remove well cover / close well cover.	**2a. CONTACT/CAUGHT:** Pinch points and scrapes associated with hand tools and well covers. **2b. FALL:** Potential tripping hazards associated with installing bolts. **2c. EXERTION:** Physical exertion to remove bolts that were over torqued or stripped.	2a. Keep hands away from pinch points. 2a. Use hand tools with extensions to remove and replace well covers. 2a. Wear cut-resistant gloves. 2a. Use knee pads or kneeling pad when repetitive kneeling on rough ground is anticipated. 2b. Place security bolts in secure location so not to create tripping hazards. Replace security bolts so that they fit flush with monitoring well covers. 2c. Replace any security bolts that show signs of stripping. Do not over tighten. 2c. Use body positioning and bending techniques that minimize muscle strain; keep back straight, bend at the knees. 2c. See 2a.

---

[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, tension/compression, torque.

[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. Screen vapor point with PID.	**3a. FALL:** Potential tripping hazards associated with equipment. **3b. EXPOSURE:** Inhalation of soil vapor	3a. Place equipment in one area close to the sampling location. 3b. Identify area where equipment is to be stored within the work area (away from main walking path). 3a. Don't leave equipment on the ground. Return equipment to storage area between uses. 3b. Replace brass caps immediately upon completion to avoid soil vapors migrating to the surface through sample tubing. 3b. Stand upwind of sample point during screening activities.
4. Remove / replace brass caps at the end of the sam`ple tubing.	**4a. CONTACT:** Pinch points associated with hand tools and brass caps. **4b. EXPOSURE:** Potential pathway for vapors to migrate to land surface.	4a. Use wrench to remove and replace brass caps. 4a. Wear cut-resistant gloves to protect against pinch points and scrapes. 4b. See 3b. 4b. Stand up wind of sample point location.
5. Set up soil vapor sampling equipment and calibration of meters.	**5a. FALL:** Potential tripping hazards associated with equipment and tubing.5b. **5b. CONTACT:** Pinch points associated with handling equipment. **5c. EXPOSURE:** Inhalation of calibration gas and helium.	5a. See 3a. 5a. Keep tubing slack to a minimum and locate the summa canister as close to the sampling location as possible. 5a. Avoid stepping over equipment and tubing. 5b. Do not place fingers/hands under sampling equipment. 5b. Make multiple trips when unloading equipment in work area. 5b. Wear cut-resistant gloves to protect against pinch points while handling sampling equipment. 5c. Review SDS for each type of calibration gas used before calibrating. 5c. Calibrate meters in a well-ventilated area and keep air flow regulator away from face. 5c. Close valve on canisters after use to avoid inhalation of excess helium or calibration gas. 5c. Stand up wind of bucket during helium tracer gas test.
6. Cleaning Work Area.	**6a. FALL:** Potential tripping hazards associated with equipment and tubing. **6b. CONTACT:** Storing and transport of equipment in car.	6a. See 3a. 6a. See 3b. 6b. Ensure that equipment is placed securely in the vehicle. Do not stack equipment on top of each other. Secure equipment so that it will not slide while being transported. 6b. Wear cut-resistant gloves while handling/loading equipment.

---

[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, tension/compression, torque.

[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".

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
☒ HARD HAT
☒ LONG SLEEVED SHIRT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES
☐ GOGGLES
☐ FACE SHIELD
☐ HEARING PROTECTION
☒ SAFETY SHOES: Steel-/Composite-toe boots/shoes
☐ Particulate Respirator
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective clothing
☒ GLOVES: Cut resistant / leather
☐ OTHER:

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.	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. Fall : Slip/Trip/Fall	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.

---

[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".

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.

---

[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.

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-025**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 1

JSA TYPE CATEGORY **Generic**	WORK TYPE **General**	WORK ACTIVITY (Description) **Trucking**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Lauren Dolginko	Project Geologist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST
☒ HARD HAT
☐ LONG SLEEVED SHIRT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES

☐ GOGGLES
☐ FACE SHIELD
☐ HEARING PROTECTION
☒ SAFETY SHOES: Steel-toe boots

☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective vest or high visibility long sleeved clothing

☒ GLOVES: Leather or cut resistant
☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Heavy equipment (i.e. trucks)

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. Set up work zone.	**1a. CONTACT:** Personal injury/property damage caused by obstruction/vehicle.	1a. Establish work zone for manifesting/paperwork by communicating with workers before task begins. Maintain a minimum **Exclusion Zone (EZ)** around all heavy equipment.
2. Loading of truck.	**2a. CONTACT:** Rolling Vehicle could cause bodily harm. **2b. CONTACT:** Machine or load may crush personnel, property or machinery. **2c. CONTACT:** Load shifting during travel.	2a. All commercial vehicles without an operator must have their engines off and wheels chocked. Truck and loading area should be on level ground. 2b. All machines (Excavator, Lull, Backhoe) must have a spotter. Spotter must communicate contact hazards such as other personnel in the work area, objects in the machine's blind spot, and overhead lines to the operator. Spotter and operator should have 2-way radios or established hand signals to communicate when needed. 2b. Loads must not be swung over other vehicles or personnel. 2b. Maintain **EZ** around all equipment. 2c. Secure all loads prior to moving the truck with chains or straps or cribbing. 2c. Any loose soil or debris should be cleaned off truck sides prior to truck mobilization. 2c. All truck beds must be secured prior to traveling.
3. Dumping loads.	**3a. CONTACT:** Truck may flip sideways or backwards.	3a. All workers must stay behind and away from the side of trucks that are dumping to avoid contact with the truck potentially tipping sideways or backwards. EZ must be maintained equal to the height of bed while lifted.
4. Exchanging paperwork with truck driver.	**4a. CONTACT/CAUGHT:** Broken bones from contact by vehicle. **4b. FALL:** Slip, Trip or Fall may cause muscle strains or tears, abrasions or lacerations, or broken bones.	4a. Truck driver should exit truck with proper PPE and enter the established work zone to complete paperwork. If Site-specific safety prohibits drivers from exiting the truck, wait until truck is finished loading, with engine turned off, before approaching truck. 4a. Always establish eye contact with driver prior to approaching truck. 4a. Confirm sides of truck have been cleaned/brushed off prior to approaching truck. 4b. Survey walking route to identify slip/trip/fall hazards. Avoid icy/wet surfaces. Remove slip/trip/fall hazards if present. 4b. Communicate with driver and spotter prior to approaching truck. Maintain **EZ** around all heavy equipment.

---

[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".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-026**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **O&M**	WORK ACTIVITY (Description) **Vac Truck Product Pump Out of ASTs and Drums**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Alfredo Fernandez	Staff Scientist	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 ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: High Visibility clothing, Tyvek suit (if needed), fire retardant suit	☒ GLOVES: Cut Restant / Leather / Nitrile / Chemical resistant ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: vac hoses, 5-gas meter (multi-gas meter), 20 lb. Type ABC fire extinguishers, safety cones, rigid barriers
Recommended: sunscreen/bug repellent (as needed)

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. Calibrate multi-gas meter	**1a. EXPOSURE:** Calibration gas.	1a. Outside of work area calibrate the multi-gas meter while wearing nitrile gloves and safety glasses. 1a. Ensure cal gas is contained. Avoid inhalation of the gas.
2. Perform Vac Truck Inspection	**2b. CONTACT:** With personnel and structures	2a. Don appropriate PPE including high visibility clothing. 2b. Prior to moving truck, perform a visual check of the critical parts with the driver and complete appropriate checklist.
3. Setup Vac Truck and Work area	**3a. CONTACT:** With personnel and structures.	3a. Don high visibility clothing. 3a. Prior to moving truck, review where truck is to be positioned and secure work area with 42” traffic cones and rigid barrier/snow fence. 3a. Review hand signals with driver prior to backing and use a spotter at all times while moving the vehicle. 3a. Chock wheels once in place.
	3b. CAUGHT: In the line of fire of vac truck while backing. Caught in pinch points while making hose connections.	3b. Back up spotter must position him/herself to “leave him/herself an out”. Stay out of the line of fire of the truck. 3b. Keep hands clear of potential pinch points while making hose connections (i.e., cam fittings); wear cut-resistant gloves.
	3c. SLIP/TRIP/FALL: Hazards from any debris in the immediate area.	3c. Inspect work area for slip, trip or fall hazards and remove or delineate. Designate a walking path free of debris. 3c. Stage tools and equipment out of walking surfaces to prevent slip/trip/falls. Maintain good housekeeping. 3c. Minimize vac hose/bond wire lengths and setup outside of walking paths.
	3d. EXPOSURE: Biological hazards. Contaminants in or on vac hose Loud noise from truck.	3d. Inspect work area for signs of biological inhabitation (insect nests or activity, animal signs). 3d. Use permethrin and DEET when working in grassy locations to prevent tick and insect exposure. 3d. Wear light clothing when possible and conduct a tick/insect check routinely. 3d. Wear nitrile gloves and keep hose clean with absorbent pads. 3d. Minimize duration or work around loud equipment if possible. Don hearing protection when noise levels exceed 85 dBA.
	3e. ERGONOMICS: From setting up work area and vac hoses.	3e. Utilize correct body positioning (i.e., knees bent, back straight, shoulders square). 3e. Do not reach more than an arm’s length away to obtain an item. 3e. Do not lift loads over 50lbs without additional assistance.
	3f. ENERGY: Static electricity.	3f. Verify truck is either bonded to vessel that is being vacuumed or that the truck is grounded.

---

[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."

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
4. Perform Vac Activities.	**4a. SLIP/TRIP/FALL:** Hazards from any debris in the immediate area. **4b. CAUGHT:** In crush/pinch points associated with vac truck valve handles. **4c. TRIP/SLIP/FALL:** Hazards from any debris in the immediate area. **4d. EXPOSURE:** Liquids, noise, and vapors.	4a. Maintain distance of 10 feet from vac hose/truck while operating. 4a. Ensure vac truck wheels are chocked. 4b. Keep hands clear of potential pinch points while making hose connections (i.e., cam fittings); wear cut-resistant gloves. 4c. See 3c. 4d. Secure hose connections prior to beginning vac activities (fully latched and close pin engaged). 4d. Upon completing vac activities, wipe down equipment with absorbent pads, as necessary. 4d. Don nitrile gloves while handling impacted equipment. 4d. Monitor breathing zone with multi-gas meter. 4d. Minimize duration or work around loud equipment if possible. Don hearing protection if noise exceeds 85 dBA.
4. Obtain tank level measurement / Pack truck for departure.	**5a. SLIP/TRIP/FALLS:** From tools and equipment in the work area. Climbing fixed ladder to gauge truck. **5b. ERGONOMICS:** Opening vac truck dome. **5c. EXPOSURE:** Petroleum-impacted materials. **5d. CAUGHT:** Pinch points when closing dome, storage boxes.	5a. See 3c. 5a. Prior to ascending truck ladder, verify that it is secure and in good condition (i.e., all steps intact, no signs of rot, no missing hardware). Use three points of contact at all times. 5a. If vac truck is equipped with a catwalk and guardrails, verify that they are structurally sound. 5a. Don harness and attach lanyard to anchor point if truck is not equipped with catwalk around dome of truck. Inspect harness and lanyard for tears prior to use. 5b. See 3c. 5c. Wipe down gauge stick over dome so as not to drip liquids on truck or ground. 5c. See 4d. 5d. See 4b.

---

[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".

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	

---

[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."

	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.

---

[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".

APPENDIX B

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

Material Safety Data Sheet

Helium

Airgas®

Section 1. Chemical product and company identification

Product name : Helium

Supplier : AIRGAS INC., on behalf of its subsidiaries
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

Product use : Synthetic/Analytical chemistry.

Synonym : helium (dot); Helium-4; He; o-Helium; UN 1046; UN 1963; Liquid Helium; Helium, Refrigerated Liquid

MSDS # : 001025

Date of Preparation/Revision : **8/27/2010.**

In case of emergency : 1-866-734-3438

Section 2. Hazards identification

Physical state : Gas. [Colorless, Odorless Gas, Cryogenic liquid and gas]

Emergency overview : WARNING!

GAS:
CONTENTS UNDER PRESURE.
Do not puncture or incinerate container.
Can cause rapid suffocation.
May cause severe frostbite.
LIQUID:
Extremely cold liquid and gas under pressure.
Can cause rapid suffocation.
May cause severe frostbite.

Do not puncture or incinerate container.

Contact with rapidly expanding gases or liquids can cause frostbite.

Routes of entry : Inhalation

Potential acute health effects

- **Eyes** : Contact with rapidly expanding gas may cause burns or frostbite. Contact with cryogenic liquid can cause frostbite and cryogenic burns.
- **Skin** : Contact with rapidly expanding gas may cause burns or frostbite. Contact with cryogenic liquid can cause frostbite and cryogenic burns.
- **Inhalation** : Acts as a simple asphyxiant.
- **Ingestion** : Ingestion is not a normal route of exposure for gases. Contact with cryogenic liquid can cause frostbite and cryogenic burns.

Potential chronic health effects : **CARCINOGENIC EFFECTS**: Not available.
MUTAGENIC EFFECTS: Not available.
TERATOGENIC EFFECTS: Not available.

Medical conditions aggravated by over-exposure : Acute or chronic respiratory conditions may be aggravated by overexposure to this gas.

See toxicological information (section 11)

Section 3. Composition, Information on Ingredients

Name	CAS number	% Volume	Exposure limits
Helium	7440-59-7	100	Oxygen Depletion [Asphyxiant]

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training.If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus.It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact	: Check for and remove any contact lenses. Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical attention immediately.
Skin contact	: None expected.
Frostbite	: Try to warm up the frozen tissues and seek medical attention.
Inhalation	: Move exposed person to fresh air. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.
Ingestion	: As this product is a gas, refer to the inhalation section.

Section 5. Fire-fighting measures

Flammability of the product	: Non-flammable.
Products of combustion	: No specific data.
Fire-fighting media and instructions	: Use an extinguishing agent suitable for the surrounding fire. Apply water from a safe distance to cool container and protect surrounding area. If involved in fire, shut off flow immediately if it can be done without risk. Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.
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	: Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (section 8). Shut off gas supply if this can be done safely. Isolate area until gas has dispersed.
Environmental precautions	: Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.
Methods for cleaning up	: Immediately contact emergency personnel. Stop leak if without risk. Note: see section 1 for emergency contact information and section 13 for waste disposal.

Section 7. Handling and storage

Handling	: High pressure gas. 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. Never allow any unprotected part of the body to touch uninsulated pipes or vessels that contain cryogenic liquids. Prevent entrapment of liquid in closed systems or piping without pressure relief devices. Some materials may become brittle at low temperatures and will easily fracture.

Storage : 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).
For additional information concerning storage and handling refer to Compressed Gas Association pamphlets P-1 Safe Handling of Compressed Gases in Containers and P-12 Safe Handling of Cryogenic Liquids available from the Compressed Gas Association, Inc.

Section 8. Exposure controls/personal protection

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.

Personal protection

Eyes : 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 or dusts.

When working with cryogenic liquids, wear a full face shield.

Skin : 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.

Respiratory : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. 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.

The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Hands : 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.

Insulated gloves suitable for low temperatures

Personal protection in case of a large spill : Self-contained breathing apparatus (SCBA) should be used to avoid inhalation of the product.

Product name	
helium	Oxygen Depletion [Asphyxiant]

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

Molecular weight : 4 g/mole

Molecular formula : He

Boiling/condensation point : -268.9°C (-452°F)

Melting/freezing point : -272.2°C (-458°F)

Critical temperature : -267.9°C (-450.2°F)

Vapor density : 0.14 (Air = 1) Liquid Density@BP: 7.8 lb/ft3 (125 kg/m3)

Specific Volume (ft ^{3}/lb) : 96.1538

Gas Density (lb/ft ^{3}) : 0.0104

Section 10. Stability and reactivity

Stability and reactivity : The product is stable.

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

Toxicity data

Other toxic effects on humans : No specific information is available in our database regarding the other toxic effects of this material to humans.

Specific effects

Carcinogenic effects : No known significant effects or critical hazards.

Mutagenic effects : No known significant effects or critical hazards.

Reproduction toxicity : No known significant effects or critical hazards.

Section 12. Ecological information

Aquatic ecotoxicity

Not available.

Environmental fate : Not available.

Environmental hazards : No known significant effects or critical hazards.

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation.Return cylinders with residual product to Airgas, Inc.Do not dispose of locally.

Section 14. Transport information

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional information
DOT Classification	UN1046 UN1963	HELIUM, COMPRESSED Helium, refrigerated liquid	2.2	Not applicable (gas).		**Limited quantity** Yes. **Packaging instruction** **Passenger aircraft** Quantity limitation: 75 kg **Cargo aircraft** Quantity limitation: 150 kg
TDG Classification	UN1046 UN1963	HELIUM, COMPRESSED Helium, refrigerated liquid	2.2	Not applicable (gas).		**Explosive Limit and Limited Quantity Index** 0.125 **Passenger Carrying Road or Rail Index** 75

Helium

Mexico Classification	UN1046	HELIUM, COMPRESSED	2.2	Not applicable (gas).		-
	UN1963	Helium, refrigerated liquid				

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Section 15. Regulatory information

United States

U.S. Federal regulations : **United States inventory (TSCA 8b):** This material is listed or exempted.

SARA 302/304/311/312 extremely hazardous substances: No products were found.
SARA 302/304 emergency planning and notification: No products were found.
SARA 302/304/311/312 hazardous chemicals: helium
SARA 311/312 MSDS distribution - chemical inventory - hazard identification: helium: Sudden release of pressure

Clean Water Act (CWA) 307: No products were found.

Clean Water Act (CWA) 311: No products were found.

Clean Air Act (CAA) 112 accidental release prevention: No products were found.

Clean Air Act (CAA) 112 regulated flammable substances: No products were found.

Clean Air Act (CAA) 112 regulated toxic substances: No products were found.

State regulations : **Connecticut Carcinogen Reporting:** This material is not listed.
Connecticut Hazardous Material Survey: This material is not listed.
Florida substances: This material is not listed.
Illinois Chemical Safety Act: This material is not listed.
Illinois Toxic Substances Disclosure to Employee Act: This material is not listed.
Louisiana Reporting: This material is not listed.
Louisiana Spill: This material is not listed.
Massachusetts Spill: This material is not listed.
Massachusetts Substances: This material is listed.
Michigan Critical Material: This material is not listed.
Minnesota Hazardous Substances: This material is not listed.
New Jersey Hazardous Substances: This material is listed.
New Jersey Spill: This material is not listed.
New Jersey Toxic Catastrophe Prevention Act: This material is not listed.
New York Acutely Hazardous Substances: This material is not listed.
New York Toxic Chemical Release Reporting: This material is not listed.
Pennsylvania RTK Hazardous Substances: This material is listed.
Rhode Island Hazardous Substances: This material is not listed.

Canada

WHMIS (Canada) : Class A: Compressed gas.

CEPA Toxic substances: This material is not listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is not listed.
Alberta Designated Substances: This material is not listed.
Ontario Designated Substances: This material is not listed.
Quebec Designated Substances: This material is not listed.

Section 16. Other information

United States

Label requirements : GAS:
CONTENTS UNDER PRESURE.
Do not puncture or incinerate container.
Can cause rapid suffocation.
May cause severe frostbite.
LIQUID:
Extremely cold liquid and gas under pressure.
Can cause rapid suffocation.
May cause severe frostbite.

Canada

Label requirements : Class A: Compressed gas.

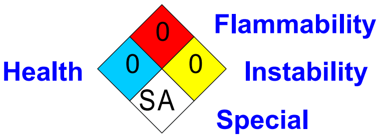
Hazardous Material Information System (U.S.A.) :

Health	1
Flammability	0
Physical hazards	0

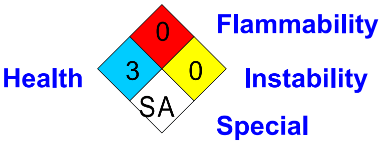
liquid:

Health	3
Fire hazard	0
Reactivity	0
Personal protection	

National Fire Protection Association (U.S.A.) :

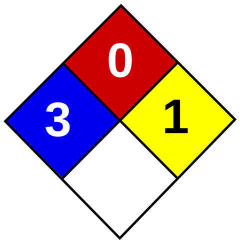


liquid:



Notice to reader

ScienceLab.com
Chemicals & Laboratory Equipment



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.

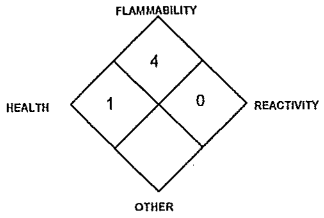
Created: 10/09/2005 05:45 PM

Last Updated: 05/21/2013 12:00 PM

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

NFPA RATING



PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: **ISOBUTYLENE - C_4H_8**
Document Number: Isobutylene

PRODUCT USE: For general analytical/synthetic chemical uses.

SUPPLIER/MANUFACTURER'S NAME: MESA Specialty Gases & Equipment
ADDRESS: 3619 Pendleton Avenue, Suite C
Santa Ana, CA 92704

BUSINESS PHONE: 1-714-434-7102
EMERGENCY PHONE: INFOTRAC: 1-800-535-5053

DATE OF PREPARATION: May 10, 1999

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIH		OSHA		IDLH ppm	OTHER
			TLV ppm	STEL ppm	PEL ppm	STEL ppm		
Isobutylene	115-11-7	> 99.0%	There are no specific exposure limits for Isobutylene. Isobutylene is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					
Maximum Impurities		< 1.0%	None of the trace impurities in this mixture contribute significantly to the hazards associated with the product. All hazard information pertinent to this product has been provided in this Material Safety Data Sheet, per the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200) and State equivalent standards.					

NE = Not Established C = Ceiling Limit See Section 16 for Definitions of Terms Used

NOTE: All WHMIS required information is included. It is located in appropriate sections based on the ANSI Z400.1-1993 format.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Isobutylene is a colorless, liquefied, flammable gas with an unpleasant odor similar to burning coal. The liquefied gas rapidly turns into a gas at standard atmospheric temperatures and pressures. Isobutylene is an asphyxiant and presents a significant health hazard by displacing the oxygen in the atmosphere. Rapid evaporation of liquid from the cylinder may cause frostbite. Both the liquid and gas pose a serious fire hazard when accidentally released. The gas is heavier than air and may travel to a source of ignition and flash back to a leak or open container. Flame or high temperature impinging on a localized area of a cylinder of Isobutylene can cause the cylinder to rupture without activating the cylinder's relief devices. Provide adequate fire protection during emergency response situations.

SYMPTOMS OF OVEREXPOSURE BY ROUTE OF EXPOSURE: The most significant route of overexposure for this gas is by inhalation. The following paragraphs describe symptoms of exposure by route of exposure.

INHALATION: High concentrations of this gas can cause an oxygen-deficient environment. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of overexposure, death may occur. Isobutylene also has some degree of anesthetic action and can be mildly irritating to the mucous membranes. The effects associated with various levels of oxygen are as follows:

CONCENTRATION	**SYMPTOMS OF EXPOSURE**
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea and vomiting, collapse or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

OTHER POTENTIAL HEALTH EFFECTS: Contact with liquid or rapidly expanding gases (which are released under high pressure) may cause frostbite. Symptoms of frostbite include change in skin color to white or grayish-yellow. The pain after such contact can quickly subside.

HAZARDOUS MATERIAL INFORMATION SYSTEM

HEALTH (BLUE)	1
FLAMMABILITY (RED)	4
REACTIVITY (YELLOW)	0
PROTECTIVE EQUIPMENT	B

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications

See Section 16 for Definition of Ratings

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Lay Terms**. Overexposure to Isobutylene may cause the following health effects:

ACUTE: The most significant hazard associated with this gas is inhalation of oxygen-deficient atmospheres. Symptoms of oxygen deficiency include respiratory difficulty, headache, dizziness, and nausea. At high concentrations, unconsciousness or death may occur. Contact with liquefied gas or rapidly expanding gases may cause frostbite.

CHRONIC: There are currently no known adverse health effects associated with chronic exposure to Isobutylene.

TARGET ORGANS: Respiratory system.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO ISOBUTYLENE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus and Fire-Retardant Personal Protective equipment should be worn. Adequate fire protection must be provided during rescue situations.

4. FIRST-AID MEASURES (Continued)

Remove victim(s) to fresh air as quickly as possible. Trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation, if necessary. Only trained personnel should administer supplemental oxygen.

In case of frostbite, place the frostbitten part in warm water. DO NOT USE HOT WATER. If warm water is not available, or is impractical to use, wrap the affected parts gently in blankets. Alternatively, if the fingers or hands are frostbitten, place the affected area in the armpit. Encourage victim to gently exercise the affected part while being warmed. Seek immediate medical attention.

Victim(s) must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to physician or other health professional with victim(s).

5. FIRE-FIGHTING MEASURES

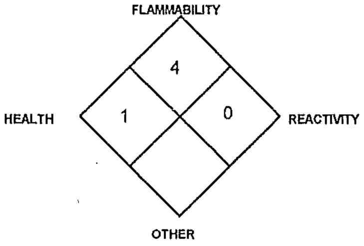
FLASH POINT (Closed Cup): -10°C (< 14°F)
AUTOIGNITION TEMPERATURE: 465°C (869°F)
FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): 1.8%
Upper (UEL): 9.6%

FIRE EXTINGUISHING MATERIALS: Extinguish Isobutylene fires by shutting off the source of the gas. Use water spray or a foam agent to cool fire-exposed containers, structures, and equipment.

UNUSUAL FIRE AND EXPLOSION HAZARDS: When involved in a fire, this material may ignite and produce toxic gases, including carbon monoxide and carbon dioxide.

NFPA RATING



See Section 16 for Definition of Ratings

DANGER! Fires impinging (direct flame) on the outside surface of unprotected pressure storage vessels of Isobutylene can be very dangerous. Direct flame exposure on the cylinder wall can cause an explosion either by BLEVE (Boiling Liquid Expanding Vapor Explosion), or by exothermic decomposition. This is a catastrophic failure of the vessel releasing the contents into a massive fireball and explosion. The resulting fire and explosion can result in severe equipment damage and personnel injury or death over a large area around the vessel. For massive fires in large areas, use unmanned hose holder or monitor nozzles; if this is not possible, withdraw from area and allow fire to burn.

Explosion Sensitivity to Mechanical Impact: Not sensitive.
Explosion Sensitivity to Static Discharge: Static discharge may cause Isobutylene to ignite explosively if released.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. The best fire-fighting technique may be simply to let the burning gas escape from the pressurized cylinder, tank car, or pipeline. Stop the leak before extinguishing fire. If the fire is extinguished before the leak is sealed, the leaking gas could explosively re-ignite without warning and cause extensive damage, injury, or fatality. In this case, increase ventilation (in enclosed areas) to prevent flammable or explosive mixture formation. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Because of the potential for a BLEVE, evacuation of non-emergency personnel is essential. If water is not available for cooling or protection of vessel exposures, evacuate the area. Refer to the North American Emergency Response Guidebook for additional information. Other information for pre-planning can be found in the American Petroleum Institute Publications 2510 and 2510A.

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a release, clear the affected area, protect people, and respond with trained personnel. Adequate fire protection must be provided. Minimum Personal Protective Equipment should be **Level B: fire-retardant protective clothing, gloves resistant to tears, and Self-Contained Breathing Apparatus.**

Use only non-sparking tools and equipment. Locate and seal the source of the leaking gas. Protect personnel attempting the shut off with water spray. Allow the gas to dissipate. Monitor the surrounding area for combustible gas levels and oxygen. Combustible gas concentration must be below 10% of the LEL (LEL = 1.8%) prior to entry. The atmosphere must have at least 19.5 percent oxygen before personnel can be allowed in the area without Self-Contained Breathing Apparatus. Attempt to close the main source valve prior to entering the area. If this does not stop the release (or if it is not possible to reach the valve), allow the gas to release in place or remove it to a safe area and allow the gas to be released there.

THIS IS AN EXTREMELY FLAMMABLE GAS. Protection of all personnel and the area must be maintained.

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Isobutylene IN YOU. Do not eat or drink while handling chemicals. Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of Isobutylene could occur without any significant warning symptoms.

STORAGE AND HANDLING PRACTICES: Cylinders should be stored in dry, well-ventilated areas away from sources of heat. Compressed gases can present significant safety hazards. Store containers away from heavily trafficked areas and emergency exits. Post "No Smoking or Open Flames" signs in storage or use areas.

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52°C (125°F). Isolate from oxidizers such as oxygen, chlorine, or fluorine. Use a check valve or trap in the discharge line to prevent hazardous backflow. Post "No Smoking or Open Flame" signs in storage and use areas. Cylinders should be stored upright and be firmly secured to prevent falling or being knocked over. Cylinders can be stored in the open, but in such cases, should be protected against extremes of weather and from the dampness of the ground to prevent rusting. Never tamper with pressure relief devices in valves and cylinders. Electrical equipment should be non-sparking or explosion proof. The following rules are applicable to situations in which cylinders are being used:

Before Use: Move cylinders with a suitable hand truck. Do not drag, slide, or roll cylinders. Do not drop cylinders or permit them to strike each other. Secure cylinders firmly. Leave the valve protection cap, if provided, in place until cylinder is ready for use.

During Use: Use designated CGA fittings and other support equipment. Do not use adapters. Do not heat cylinder by any means to increase the discharge rate of the product from the cylinder. Use check valve or trap in discharge line to prevent hazardous backflow into the cylinder. Do not use oils or grease on gas-handling fittings or equipment.

After Use: Close main cylinder valve. Replace valve protection cap, if provided. Mark empty cylinders "EMPTY".

NOTE: Use only DOT or ASME code containers. Earth-ground and bond all lines and equipment associated with Isobutylene. Close valve after each use and when empty. Cylinders must not be recharged except by or with the consent of owner. For additional information refer to the Compressed Gas Association Pamphlet P-1, *Safe Handling of Compressed Gases in Containers.* Additionally, refer to CGA Bulletin SB-2 "*Oxygen Deficient Atmospheres*".

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Purge gas handling equipment with inert gas (e.g., nitrogen) before attempting repairs.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation. Local exhaust ventilation is preferred, because it prevents Isobutylene dispersion into the work place by eliminating it at its source. If appropriate, install automatic monitoring equipment to detect the presence of potentially explosive air-gas mixtures and level of oxygen.

RESPIRATORY PROTECTION: Maintain oxygen levels above 19.5% in the workplace. Maintain level of gas below the level listed in Section 2 (Composition and Information on Ingredients). Use supplied air respiratory protection if oxygen levels are below 19.5% or during emergency response to a release of Isobutylene. If respiratory protection is required, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent State standards.

EYE PROTECTION: Splash goggles or safety glasses, for protection from rapidly expanding gases and splashes of liquid Isobutylene.

HAND PROTECTION: Wear gloves resistant to tears when handling cylinders of Isobutylene. Use low-temperature protective gloves (e.g., Kevlar) when working with containers of liquid Isobutylene.

BODY PROTECTION: Use body protection appropriate for task. Transfer of large quantities under pressure may require protective equipment appropriate to protect employees from splashes of liquefied product, as well as fire retardant items.

9. PHYSICAL and CHEMICAL PROPERTIES

VAPOR DENSITY @ 21.1°C (70°F): 2.396 kg/m^3 (0.1496 lb/ft^3)
SPECIFIC GRAVITY (air = 1): 1.997
SOLUBILITY IN WATER: Insoluble.
EVAPORATION RATE (nBuAc = 1): Not applicable.
ODOR THRESHOLD: Not established.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.
pH: Not applicable.
FREEZING POINT: -140°C (-220.6°F)
BOILING POINT @ 1 atm: -6.9°C (19.6°F)
EXPANSION RATIO: Not applicable
VAPOR PRESSURE (psia): 39
SPECIFIC VOLUME (ft^3/lb): 6.7

APPEARANCE AND COLOR: Colorless gas with the unpleasant odor of burning coal. The liquid is also colorless and has the same unpleasant odor of burning coal.

HOW TO DETECT THIS SUBSTANCE (warning properties): There are no distinct warning properties. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation.

10. STABILITY and REACTIVITY

STABILITY: Stable.

DECOMPOSITION PRODUCTS: When ignited in the presence of oxygen, this gas will burn to produce carbon monoxide and carbon dioxide.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong oxidizers (e.g., chlorine, bromine pentafluoride, oxygen, oxygen difluoride, and nitrogen trifluoride).

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials and exposure to heat, sparks, and other sources of ignition. Cylinders exposed to high temperatures or direct flame can rupture or burst.

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following information is for pure Isobutylene.

ISOBUTYLENE:
LC_{50} (rat, inhalation) = 620 g/m^3/4 hours
LC_{50} (mouse, inhalation) = 415 g/m^3/2 hours

SUSPECTED CANCER AGENT: Isobutylene is not found on the following lists: FEDERAL OSHA Z LIST, NTP, IARC, CAL/OSHA, and therefore is neither considered to be nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Isobutylene may be mildly irritating to the mucous membranes. In addition, contact with rapidly expanding gases can cause frostbite to exposed tissue.

SENSITIZATION TO THE PRODUCT: Isobutylene is not known to cause sensitization in humans.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Isobutylene on the human reproductive system.

Mutagenicity: No mutagenic effects have been described for Isobutylene.
Embryotoxicity: No embryotoxic effects have been described for Isobutylene.
Teratogenicity: No teratogenic effects have been described for Isobutylene.
Reproductive Toxicity: No reproductive toxicity effects have been described for Isobutylene.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e., within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Acute or chronic respiratory conditions may be aggravated by overexposure to Isobutylene.

11. TOXICOLOGICAL INFORMATION (Continued)

RECOMMENDATIONS TO PHYSICIANS: Administer oxygen, if necessary. Treat symptoms and eliminate exposure.

BIOLOGICAL EXPOSURE INDICES (BEIs): Currently, Biological Exposure Indices (BEIs) are not applicable for Isobutylene.

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: This gas will be dissipated rapidly in well-ventilated areas.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Any adverse effect on animals would be related to oxygen-deficient environments. No adverse effect is anticipated to occur to plant life, except for frost produced in the presence of rapidly expanding gases. See Section 11, Toxicological Information, for additional information on effects on animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on the effects of Isobutylene on aquatic life.

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Return cylinders with any residual product to MESA Specialty Gases & Equipment Do not dispose of locally.

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

For Isobutylene Gas:

PROPER SHIPPING NAME:	Isobutylene
HAZARD CLASS NUMBER and DESCRIPTION:	2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 1055
PACKING GROUP:	Not Applicable
DOT LABEL(S) REQUIRED:	Flammable Gas

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115

Alternate Description:

PROPER SHIPPING NAME:	Petroleum gases, liquefied
HAZARD CLASS NUMBER and DESCRIPTION:	2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER:	UN 1075
PACKING GROUP:	Not Applicable
DOT LABEL(S) REQUIRED:	Flammable Gas

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115

MARINE POLLUTANT: Isobutylene is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: THIS MATERIAL IS CONSIDERED AS DANGEROUS GOODS. Use the above information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

U.S. SARA REPORTING REQUIREMENTS: Isobutylene is not subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act.

U.S. SARA THRESHOLD PLANNING QUANTITY: Not applicable.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Not applicable.

CANADIAN DSL/NDSL INVENTORY STATUS: Isobutylene is on the DSL Inventory.

U.S. TSCA INVENTORY STATUS: Isobutylene is listed on the TSCA Inventory.

15. REGULATORY INFORMATION (Continued)

OTHER U.S. FEDERAL REGULATIONS: Isobutylene is subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for this gas is 10,000 lb. Depending on specific operations involving the use of Isobutylene, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Under this regulation Isobutylene is not listed in Appendix A; however, any process that involves a flammable gas on-site, in one location, in quantities of 10,000 lb (4,553 kg) or greater is covered under this regulation unless it is used as a fuel.

U.S. STATE REGULATORY INFORMATION: Isobutylene is covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Liquefied Petroleum Gas.
California - Permissible Exposure Limits for Chemical Contaminants: Liquefied Petroleum Gas.
Florida - Substance List: Isobutylene.
Illinois - Toxic Substance List: No.
Kansas - Section 302/313 List: No.
Massachusetts - Substance List: Isobutylene.
Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: Liquefied Petroleum Gas.
Missouri - Employer Information/Toxic Substance List: No.
New Jersey - Right to Know Hazardous Substance List: Isobutylene.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: No.
Pennsylvania - Hazardous Substance List: Isobutylene.
Rhode Island - Hazardous Substance List: Liquefied Petroleum Gas.
Texas - Hazardous Substance List: Liquefied Petroleum Gas.
West Virginia - Hazardous Substance List: Liquefied Petroleum Gas.
Wisconsin - Toxic and Hazardous Substances: Liquefied Petroleum Gas.

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): Isobutylene is not on the California Proposition 65 lists.

LABELING:

DANGER:

FLAMMABLE LIQUID AND GAS UNDER PRESSURE.
CAN FORM EXPLOSIVE MIXTURES WITH AIR.
MAY CAUSE FROSTBITE.

Keep away from heat, flames, and sparks.
Store and use with adequate ventilation.
Cylinder temperature should not exceed 52°C (125°F).
Do not get liquid in eyes, on skin, or clothing.
Close valve after each use and when empty.
Use in accordance with the Material Safety Data Sheet.

FIRST AID:

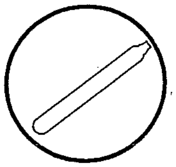
IF INHALED, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

IN CASE OF FROSTBITE, obtain immediate medical attention.

DO NOT REMOVE THIS PRODUCT LABEL.

CANADIAN WHMIS SYMBOLS:

Class A: Compressed Gas
Class B1: Flammable Gas



16. OTHER INFORMATION

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. MESA Specialty Gases & Equipment assumes no responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, MESA Specialty Gases & Equipment assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent. It is used for computer-related searching.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV** - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration. **PEL** - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order.

IDLH - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. The **DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (OSHA). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury).

NATIONAL FIRE PROTECTION ASSOCIATION (Continued): Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

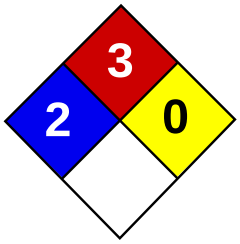
Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD_{50}** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC_{50}** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m^3** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Data from several sources are used to evaluate the cancer-causing potential of the material. The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. Ecological Information: EC is the effect concentration in water.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. EPA is the U.S. Environmental Protection Agency. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **DOT** and **TC** are the U.S. Department of Transportation and the Transport Canada, respectively. Superfund Amendments and Reauthorization Act (**SARA**); the Canadian Domestic/Non-Domestic Substances List (**DSL/NDSL**); the U.S. Toxic Substance Control Act (**TSCA**); Marine Pollutant status according to the **DOT**; the Comprehensive Environmental Response, Compensation, and Liability Act (**CERCLA or Superfund**); and various state regulations.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Benzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Benzene

Catalog Codes: SLB1564, SLB3055, SLB2881

CAS#: 71-43-2

RTECS: CY1400000

TSCA: TSCA 8(b) inventory: Benzene

CI#: Not available.

Synonym: Benzol; Benzine

Chemical Name: Benzene

Chemical Formula: C6-H6

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
Benzene	71-43-2	100

Toxicological Data on Ingredients: Benzene: ORAL (LD50): Acute: 930 mg/kg [Rat]. 4700 mg/kg [Mouse]. DERMAL (LD50): Acute: >9400 mg/kg [Rabbit]. VAPOR (LC50): Acute: 10000 ppm 7 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of eye contact (irritant), of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. The substance is toxic to blood, bone marrow, central nervous system (CNS). The substance may be toxic to liver, Urinary System. Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention immediately.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek 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 if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 497.78°C (928°F)

Flash Points: CLOSED CUP: -11.1°C (12°F). (Setaflash)

Flammable Limits: LOWER: 1.2% UPPER: 7.8%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of oxidizing materials. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Explosive in presence of oxidizing materials, of acids.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Extremely flammable liquid and vapor. Vapor may cause flash fire. Reacts on contact with iodine heptafluoride gas. Dioxygenyl tetrafluoroborate is as very powferful oxidant. The addition of a small particle to small samples of benzene, at ambient temperature, causes ignition. Contact with sodium peroxide with benzene causes ignition. Benzene ignites in contact with powdered chromic anhydride. Virgorous or incandescent reaction with hydrogen + Raney nickel (above 210 C) and bromine trifluoride.

Special Remarks on Explosion Hazards:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction

of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. 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 away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. 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, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

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:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 STEL: 2.5 (ppm) from ACGIH (TLV) [United States] TWA: 1.6 STEL: 8 (mg/m3) from ACGIH (TLV) [United States] TWA: 0.1 STEL: 1 from NIOSH TWA: 1 STEL: 5 (ppm) from OSHA (PEL) [United States] TWA: 10 (ppm) from OSHA (PEL) [United States] TWA: 3 (ppm) [United Kingdom (UK)] TWA: 1.6 (mg/m3) [United Kingdom (UK)] TWA: 1 (ppm) [Canada] TWA: 3.2 (mg/m3) [Canada] TWA: 0.5 (ppm) [Canada]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor:
Aromatic. Gasoline-like, rather pleasant. (Strong.)

Taste: Not available.

Molecular Weight: 78.11 g/mole

Color: Clear Colorless. Colorless to light yellow.

pH (1% soln/water): Not available.

Boiling Point: 80.1 (176.2°F)

Melting Point: 5.5°C (41.9°F)

Critical Temperature: 288.9°C (552°F)

Specific Gravity: 0.8787 @ 15 C (Water = 1)

Vapor Pressure: 10 kPa (@ 20°C)

Vapor Density: 2.8 (Air = 1)

Volatility: Not available.

Odor Threshold: 4.68 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Miscible in alcohol, chloroform, carbon disulfide oils, carbon tetrachloride, glacial acetic acid, diethyl ether, acetone. Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles.

Incompatibility with various substances: Highly reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Benzene vapors + chlorine and light causes explosion. Reacts explosively with bromine pentafluoride, chlorine, chlorine trifluoride, diborane, nitric acid, nitryl perchlorate, liquid oxygen, ozone, silver perchlorate. Benzene + pentafluoride and methoxide (from arsenic pentafluoride and potassium methoxide) in trichlorotrifluoroethane causes explosion. Interaction of nitryl perchlorate with benzene gave a slight explosion and flash. The solution of permanganic acid (or its explosive anhydride, dimaganese heptoxide) produced by interaction of permanganates and sulfuric acid will explode on contact with benzene. Peroxodisulfuric acid is a very powfferful oxidant. Uncontrolled contact with benzene may cause explosion. Mixtures of peroxomonsulfuric acid with benzene explodes.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 930 mg/kg [Rat]. Acute dermal toxicity (LD50): >9400 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 10000 7 hours [Rat].

Chronic Effects on Humans:

CARCINOGENIC EFFECTS: Classified A1 (Confirmed for human.) by ACGIH, 1 (Proven for human.) by IARC. MUTAGENIC EFFECTS: Classified POSSIBLE for human. Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female [POSSIBLE]. Causes damage to the following organs: blood, bone marrow, central nervous system (CNS). May cause damage to the following organs: liver, Urinary System.

Other Toxic Effects on Humans:
Very hazardous in case of inhalation. Hazardous in case of skin contact (irritant, permeator), of ingestion.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (female fertility, Embryotoxic and/or foetotoxic in animal) and birth defects. May affect genetic material (mutagenic). May cause cancer (tumorigenic, leukemia)) Human: passes the placental barrier, detected in maternal milk.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. It can be absorbed through intact skin and affect the liver, blood, metabolism,and urinary system. Eyes: Causes eye irritation. Inhalation: Causes respiratory tract and mucous membrane irritation. Can be absorbed through the lungs. May affect behavior/Central and Peripheral nervous systems (somnolence, muscle weakness, general anesthetic, and other symptoms similar to ingestion), gastrointestinal tract (nausea), blood metabolism, urinary system. Ingestion: May be harmful if swallowed. May cause gastrointestinal tract irritation including vomiting. May affect behavior/Central and Peripheral nervous systems (convulsions, seizures, tremor, irritability, initial CNS stimulation followed by depression, loss of coordination, dizziness, headache, weakness, pallor, flushing), respiration (breathlessness and chest constriction), cardiovascular system, (shallow/rapid pulse), and blood.

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 3: Flammable liquid.

Identification: : Benzene UNNA: 1114 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Benzene California prop. 65 (no significant risk level): Benzene: 0.007 mg/day (value) California prop. 65: This product contains the following ingredients

for which the State of California has found to cause cancer which would require a warning under the statute: Benzene Connecticut carcinogen reporting list.: Benzene Connecticut hazardous material survey.: Benzene Illinois toxic substances disclosure to employee act: Benzene Illinois chemical safety act: Benzene New York release reporting list: Benzene Rhode Island RTK hazardous substances: Benzene Pennsylvania RTK: Benzene Minnesota: Benzene Michigan critical material: Benzene Massachusetts RTK: Benzene Massachusetts spill list: Benzene New Jersey: Benzene New Jersey spill list: Benzene Louisiana spill reporting: Benzene California Director's list of Hazardous Substances: Benzene TSCA 8(b) inventory: Benzene SARA 313 toxic chemical notification and release reporting: Benzene CERCLA: Hazardous substances.: Benzene: 10 lbs. (4.536 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 B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R22- Harmful if swallowed. R38- Irritating to skin. R41- Risk of serious damage to eyes. R45- May cause cancer. R62- Possible risk of impaired fertility. S2- Keep out of the reach of children. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S39- Wear eye/face protection. S46- If swallowed, seek medical advice immediately and show this container or label. S53- Avoid exposure - obtain special instructions before use.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

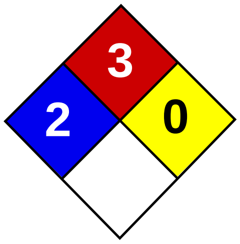
Other Special Considerations: Not available.

Created: 10/10/2005 08:35 PM

Last Updated: 11/06/2008 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet
Toluene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Toluene

Catalog Codes: SLT2857, SLT3277

CAS#: 108-88-3

RTECS: XS5250000

TSCA: TSCA 8(b) inventory: Toluene

CI#: Not available.

Synonym: Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol

Chemical Name: Toluene

Chemical Formula: C6-H5-CH3 or C7-H8

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
Toluene	108-88-3	100

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek 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.

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 medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO_2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; concentrated nitric acid, sulfuric acid + nitric acid; N_2O_4; $AgClO_4$; BrF_3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetranitromethane.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. 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. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

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:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 200 STEL: 500 CEIL: 300 (ppm) from OSHA (PEL) [United States] TWA: 50 (ppm) from ACGIH (TLV) [United States] SKIN TWA: 100 STEL: 150 from NIOSH [United States] TWA: 375 STEL: 560 (mg/m3) from NIOSH [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweet, pungent, Benzene-like.

Taste: Not available.

Molecular Weight: 92.14 g/mole

Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)

Vapor Pressure: 3.8 kPa (@ 25°C)

Vapor Density: 3.1 (Air = 1)

Volatility: Not available.

Odor Threshold: 1.6 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether, acetone.

Solubility:
Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Cauess mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abraisons. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia,), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Aspiration of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. Chronic Potential Health Effects: Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophostatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

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 3: Flammable liquid.

Identification: : Toluene UNNA: 1294 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene California prop. 65 (no significant risk level): Toluene: 7 mg/day (value) California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene Connecticut hazardous material survey.: Toluene Illinois

toxic substances disclosure to employee act: Toluene Illinois chemical safety act: Toluene New York release reporting list: Toluene Rhode Island RTK hazardous substances: Toluene Pennsylvania RTK: Toluene Florida: Toluene Minnesota: Toluene Michigan critical material: Toluene Massachusetts RTK: Toluene Massachusetts spill list: Toluene New Jersey: Toluene New Jersey spill list: Toluene Louisiana spill reporting: Toluene California Director's List of Hazardous Substances.: Toluene TSCA 8(b) inventory: Toluene TSCA 8(d) H and S data reporting: Toluene: Effective date: 10/04/82; Sunset Date: 10/0/92 SARA 313 toxic chemical notification and release reporting: Toluene CERCLA: Hazardous substances.: Toluene: 1000 lbs. (453.6 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 B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S25- Avoid contact with eyes. S29- Do not empty into drains. S33- Take precautionary measures against static discharges.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

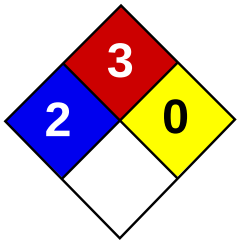
Other Special Considerations: Not available.

Created: 10/10/2005 08:30 PM

Last Updated: 11/06/2008 12:00 PM

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Ethylbenzene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylbenzene

Catalog Codes: SLE2044

CAS#: 100-41-4

RTECS: DA0700000

TSCA: TSCA 8(b) inventory: Ethylbenzene

CI#: Not available.

Synonym: Ethyl Benzene; Ethylbenzol; Phenylethane

Chemical Name: Ethylbenzene

Chemical Formula: C_8H_{10}

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
Ethylbenzene	100-41-4	100

Toxicological Data on Ingredients: Ethylbenzene: ORAL (LD50): Acute: 3500 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (irritant, sensitizer). CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. WARM water MUST be used. Get medical attention.

Skin Contact: Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

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 medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 432°C (809.6°F)

Flash Points:
CLOSED CUP: 15°C (59°F). (Tagliabue.) OPEN CUP: 26.667°C (80°F) (Cleveland) (CHRIS, 2001) CLOSED CUP: 12.8 C (55 F) (Bingham et al, 2001; NIOSH, 2001) CLOSED CUP: 21 C (70 F) (NFPA)

Flammable Limits: LOWER: 0.8% - 1.6%UPPER: 6.7% - 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances: Highly flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available. Slightly explosive in presence of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

Special Remarks on Fire Hazards:
Vapor may travel considerable distance to source of ignition and flash back. Vapors may form explosive mixtures with air. When heated to decomposition it emits acrid smoke and irritating fumes.

Special Remarks on Explosion Hazards: Vapors may form explosive mixtures in air.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. 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 away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with eyes. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame). Sensitive to light. Store in light-resistant containers.

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:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 STEL: 125 (ppm) from OSHA (PEL) [United States] TWA: 435 STEL: 545 from OSHA (PEL) [United States] TWA: 435 STEL: 545 (mg/m3) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from NIOSH [United States] TWA: 100 STEL: 125 (ppm) from ACGIH (TLV) [United States] TWA: 100 STEL: 125 (ppm) [United Kingdom (UK)] TWA: 100 STEL: 125 (ppm) [Belgium] TWA: 100 STEL: 125 (ppm) [Finland] TWA: 50 (ppm) [Norway] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish. Gasoline-like. Aromatic.

Taste: Not available.

Molecular Weight: 106.16 g/mole

Color: Colorless.

pH (1% soln/water): Not available.

Boiling Point: 136°C (276.8°F)

Melting Point: -94.9 (-138.8°F)

Critical Temperature: 617.15°C (1142.9°F)

Specific Gravity: 0.867 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.66 (Air = 1)

Volatility: 100% (v/v).

Odor Threshold: 140 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility:
Easily soluble in diethyl ether. Very slightly soluble in cold water or practically insoluble in water. Soluble in all proportions in Ethyl alcohol. Soluble in Carbon tetrachloride, Benzene. Insoluble in Ammonia. Slightly soluble in Chloroform. Solubility in Water: 169 mg/l @ 25 deg. C.; 0.014 g/100 ml @ 15 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ingnition sources (flames, sparks, static), incompatible materials, light

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Not considered to be corrosive for metals and glass.

Special Remarks on Reactivity:
Can react vigorously with oxidizing materials. Sensitive to light.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Inhalation.

Toxicity to Animals: Acute oral toxicity (LD50): 3500 mg/kg [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 2B (Possible for human.) by IARC. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Mutagenic for bacteria and/or yeast. May cause damage to the following organs: central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of ingestion, of inhalation. Slightly hazardous in case of skin contact (irritant, permeator).

Special Remarks on Toxicity to Animals:
Lethal Dose/Conc 50% Kill: LD50 [Rabbit] - Route: Skin; Dose: 17800 ul/kg Lowest Published Lethal Dose/Conc: LDL[Rat] - Route: Inhalation (vapor); Dose: 4000 ppm/4 H

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects (teratogenic) based on animal test data. May cause cancer based on animals data. IARC evidence for carcinogenicity in animals is sufficient. IARC evidence of carcinogenicity in humans inadequate. May affect genetic material (mutagenic).

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Can cause mild skin irritation. It can be absorbed through intact skin. Eyes: Contact with vapor or liquid can cause severe eye irritation depending on concentration. It may also cause conjunctivitis. At a vapor exposure level of 85 - 200 ppm , it is mildly and transiently irritating to the eyes; 1000 ppm causes further irritation and tearing; 2000 ppm results in immediate and severe irritation and tearing; 5,000 ppm is intolerable (ACGIH, 1991; Clayton and Clayton, 1994). Standard draize test for eye irritation using 500 mg resulted in severe irritation (RTECS) Inhalation: Exposure to high concentrations can cause nasal, mucous membrane and respiratory tract irritation and can also result in chest constriction and, trouble breathing, respiratory failure, and even death. It can also affect behavior/Central Nervous System. The effective dose for CNS depression in experimental animals was 10,000 ppm (ACGIH, 1991). Symptoms of CNS depression include

headache, nausea, weakness, dizziness, vertigo, irritability, fatigue, lightheadedness, sleepiness, tremor, loss of coordination, judgement and conciousness, coma, and death. It can also cause pulmonary edema. Inhalation of 85 ppm can produce fatigue, insomnia, headache, and mild irritation of the respiratory tract (Haley & Berndt, 1987). Ingestion: Do not drink, pipet or siphon by mouth. May cause gastroinestinal/digestive tract irritation with Abdominal pain, nausea, vomiting. Ethylbenzene is a pulmonary aspiration hazard. Pulmonary aspiration of even small amounts of the liquid may cause fatal pneumonitis. It may also affect behavior/central nervous system with

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 14 mg/l 96 hours [Fish (Trout)] (static). 12.1 mg/l 96 hours [Fish (Fathead Minnow)] (flow-through)]. 150 mg/l 96 hours [Fish (Blue Gill/Sunfish)] (static). 275 mg/l 96 hours [Fish (Sheepshead Minnow)]. 42.3 mg/l 96 hours [Fish (Fathead Minnow)](soft water). 87.6mg/l 96 hours [Shrimp].

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 3: Flammable liquid.

Identification: : Ethylbenzene UNNA: 1175 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Ethylbenzene Illinois toxic substances disclosure to employee act: Ethylbenzene Illinois chemical safety act: Ethylbenzene New York release reporting list: Ethylbenzene Rhode Island RTK hazardous substances: Ethylbenzene Pennsylvania RTK: Ethylbenzene Minnesota: Ethylbenzene Massachusetts RTK: Ethylbenzene Massachusetts spill list: Ethylbenzene New Jersey: Ethylbenzene New Jersey spill list: Ethylbenzene Louisiana spill reporting: Ethylbenzene California Director's List of Hazardous Substances: Ethylbenzene TSCA 8(b) inventory: Ethylbenzene TSCA 4(a) proposed test rules: Ethylbenzene TSCA 8(d) H and S data reporting: Ethylbenzene: Effective Date: 6/19/87; Sunset Date: 6/19/97 SARA 313 toxic chemical notification and release reporting: Ethylbenzene

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 B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASSE D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R11- Highly flammable. R20- Harmful by inhalation. S16- Keep away from sources of ignition - No smoking. S24/25- Avoid contact with skin and eyes. S29- Do not empty into drains.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

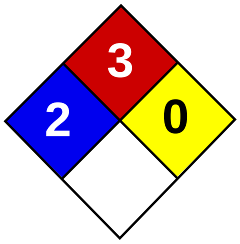
References:
-Manufacturer's Material Safety Data Sheet. -Fire Protection Guide to Hazardous Materials, 13th ed., Nationial Fire Protection Association (NFPA) -Registry of Toxic Effects of Chemical Substances (RTECS) -Chemical Hazard Response Information System (CHRIS) -Hazardous Substance Data Bank (HSDB) -New Jersey Hazardous Substance Fact Sheet -Ariel Global View -Reprotext System

Other Special Considerations: Not available.

Created: 10/09/2005 05:28 PM

Last Updated: 11/06/2008 12:00 PM

ScienceLab.com
Chemicals & Laboratory Equipment



Health	2
Fire	3
Reactivity	0
Personal Protection	H

Material Safety Data Sheet

Xylenes MSDS

Section 1: Chemical Product and Company Identification

Product Name: Xylenes

Catalog Codes: SLX1075, SLX1129, SLX1042, SLX1096

CAS#: 1330-20-7

RTECS: ZE2100000

TSCA: TSCA 8(b) inventory: Xylenes

CI#: Not available.

Synonym: Xylenes; Dimethylbenzene; xylol; methyltoluene

Chemical Name: Xylenes (o-, m-, p- isomers)

Chemical Formula: C6H4(CH3)2

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
Xylenes	1330-20-7	100

Toxicological Data on Ingredients: Xylenes: ORAL (LD50): Acute: 4300 mg/kg [Rat]. 2119 mg/kg [Mouse]. DERMAL (LD50): Acute: >1700 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects: Hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of ingestion, of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek 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 if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 464°C (867.2°F)

Flash Points: CLOSED CUP: 24°C (75.2°F). (Tagliabue.) OPEN CUP: 37.8°C (100°F).

Flammable Limits: LOWER: 1% UPPER: 7%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of heat.

Fire Fighting Media and Instructions:
Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards: Vapors may travel to source of ignition and flash back.

Special Remarks on Explosion Hazards:
Vapors may form explosive mixtures with air. Containers may explode when heated. May polymerize explosively when heated. An attempt to chlorinate xylene with 1,3-Dichloro-5,5-dimethyl-2,4-imidazolidindione (dichlorohydrantoin) caused a violent explosion

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined

areas; dike if needed. 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 away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, acids.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

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:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 100 (ppm) [Canada] TWA: 435 (mg/m3) [Canada] TWA: 434 STEL: 651 (mg/m3) from ACGIH (TLV) [United States] TWA: 100 STEL: 150 (ppm) from ACGIH (TLV) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Sweetish.

Taste: Not available.

Molecular Weight: 106.17 g/mole

Color: Colorless. Clear

pH (1% soln/water): Not available.

Boiling Point: 138.5°C (281.3°F)

Melting Point: -47.4°C (-53.3°F)

Critical Temperature: Not available.

Specific Gravity: 0.864 (Water = 1)

Vapor Pressure: 0.9 kPa (@ 20°C)

Vapor Density: 3.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 1 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.1

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Insoluble in cold water, hot water. Miscible with absolute alcohol, ether, and many other organic liquids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources, incompatibles

Incompatibility with various substances: Reactive with oxidizing agents, acids.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Store away from acetic acid, nitric acid, chlorine, bromine, and fluorine.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2119 mg/kg [Mouse]. Acute dermal toxicity (LD50): >1700 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5000 4 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, liver, mucous membranes, bone marrow, central nervous system (CNS).

Other Toxic Effects on Humans: Hazardous in case of skin contact (irritant, permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals:
Lowest Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LCL [Man] - Route: Oral; Dose: 10000 ppm/6H

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in animal. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects (male and femael fertility (spontaneous abortion and fetotoxicity)) and birth defects based animal data.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. Can be absorbed through skin. Eyes: Causes eye irritation. Inhalation: Vapor causes respiratory tract and mucous membrane irritation. May affect central nervous system and behavior (General anesthetic/CNS depressant with effects including headache, weakness, memory loss, irritability, dizziness, giddiness, loss of coordination and judgement, respiratory depression/arrest or difficulty breathing, loss of appetite, nausea, vomiting, shivering, and possible coma and death). May also affects blood, sense organs, liver, and peripheral nerves. Ingestion: May cause gastrointestinal irritation including abdominal pain, vomiting, and nausea. May also affect liver and urinary system/ kidneys. May cause effects similar to those of acute inhalation. Chronic Potential Health Effects: Chronic inhalation may affect the urinary system (kidneys) blood (anemia), bone marrow (hyperplasia of bone marrow) brain/behavior/Central Nervous system. Chronic inhalation may alsocause mucosal bleeding. Chronic ingestion may affect the liver and metabolism (loss of appetite) and may affect urinary system (kidney damage)

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 3: Flammable liquid.

Identification: : Xylenes UNNA: 1307 PG: III

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Xylenes Illinois chemical safety act: Xylenes New York acutely hazardous substances: Xylenes Rhode Island RTK hazardous substances: Xylenes Pennsylvania RTK: Xylenes Minnesota: Xylenes Michigan critical material: Xylenes Massachusetts RTK: Xylenes Massachusetts spill list: Xylenes New Jersey: Xylenes New Jersey spill list: Xylenes Louisiana spill reporting: Xylenes California Director's List of Hazardous Substances: Xylenes TSCA 8(b) inventory: Xylenes SARA 302/304/311/312 hazardous chemicals: Xylenes SARA 313 toxic chemical notification and release reporting: Xylenes CERCLA: Hazardous substances.: Xylenes: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R10- Flammable. R21- Harmful in contact with skin. R36/38- Irritating to eyes and skin. S2- Keep out of the reach of children. S36/37- Wear suitable protective clothing and gloves. S46- If swallowed, seek medical advice immediately and show this container or label.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 0

Personal Protection: h

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 3

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

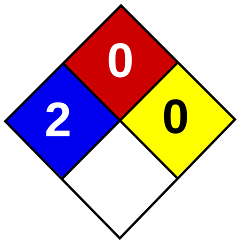
References: Not available.

Other Special Considerations: Not available.

Created: 10/11/2005 12:54 PM

Last Updated: 11/06/2008 12:00 PM

Science Lab.com
Chemicals & Laboratory Equipment



Health	2
Fire	0
Reactivity	0
Personal Protection	G

Material Safety Data Sheet

Tetrachloroethylene MSDS

Section 1: Chemical Product and Company Identification

Product Name: Tetrachloroethylene

Catalog Codes: SLT3220

CAS#: 127-18-4

RTECS: KX3850000

TSCA: TSCA 8(b) inventory: Tetrachloroethylene

CI#: Not available.

Synonym: Perchloroethylene; 1,1,2,2-Tetrachloroethylene; Carbon bichloride; Carbon dichloride; Ankilostin; Didakene; Dilatin PT; Ethene, tetrachloro-; Ethylene tetrachloride; Perawin; Perchlor; Perclene; Perclene D; Percosolvel; Tetrachloroethene; Tetraleno; Tetralex; Tetravec; Tetroguer; Tetropil

Chemical Name: Ethylene, tetrachloro-

Chemical Formula: C2-Cl4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Tetrachloroethylene	127-18-4	100

Toxicological Data on Ingredients: Tetrachloroethylene: ORAL (LD50): Acute: 2629 mg/kg [Rat]. DERMAL (LD): Acute: >3228 mg/kg [Rabbit]. MIST(LC50): Acute: 34200 mg/m 8 hours [Rat]. VAPOR (LC50): Acute: 5200 ppm 4 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of eye contact (irritant), of ingestion.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (anticipated carcinogen) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, peripheral nervous system, respiratory tract, skin, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.

Large Spill:
Absorb with an inert material and put the spilled material in an appropriate waste disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Do not ingest. Do not breathe gas/fumes/ vapor/spray. Avoid contact with skin. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, metals, acids, alkalis.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value.

Personal Protection:
Safety glasses. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 25 (ppm) from OSHA (PEL) [United States] TWA: 25 STEL: 100 (ppm) from ACGIH (TLV) [United States] TWA: 170 (mg/m3) from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Ethereal.

Taste: Not available.

Molecular Weight: 165.83 g/mole

Color: Clear Colorless.

pH (1% soln/water): Not available.

Boiling Point: 121.3°C (250.3°F)

Melting Point: -22.3°C (-8.1°F)

Critical Temperature: 347.1°C (656.8°F)

Specific Gravity: 1.6227 (Water = 1)

Vapor Pressure: 1.7 kPa (@ 20°C)

Vapor Density: 5.7 (Air = 1)

Volatility: Not available.

Odor Threshold: 5 - 50 ppm

Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 3.4

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility:
Miscible with alcohol, ether, chloroform, benzene, hexane. It dissolves in most of the fixed and volatile oils. Solubility in water: 0.015 g/100 ml @ 25 deg. C It slowly decomposes in water to yield Trichloroacetic and Hydrochloric acids.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents, metals, acids, alkalis.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Oxidized by strong oxidizing agents. Incompatible with sodium hydroxide, finely divided or powdered metals such as zinc, aluminum, magnesium, potassium, chemically active metals such as lithium, beryllium , barium. Protect from light.

Special Remarks on Corrosivity: Slowly corrodes aluminum, iron, and zinc.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 2629 mg/kg [Rat]. Acute dermal toxicity (LD50): >3228 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 5200 4 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified A3 (Proven for animal.) by ACGIH. Classified 2A (Probable for human.) by IARC, 2 (Some evidence.) by NTP. MUTAGENIC EFFECTS: Mutagenic for bacteria and/or yeast. May cause damage to the following organs: kidneys, liver, peripheral nervous system, upper respiratory tract, skin, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of inhalation. Slightly hazardous in case of skin contact (permeator), of ingestion.

Special Remarks on Toxicity to Animals:
Lowest Publishe Lethal Dose/Conc: LDL [Rabbit] - Route: Oral; Dose: 5000 mg/kg LDL [Dog] - Route: Oral; Dose: 4000 mg/kg LDL [Cat] - Route: Oral; Dose: 4000 mg/kg

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects and birth defects(teratogenic). May affect genetic material (mutagenic). May cause cancer.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation with possible dermal blistering or burns. Symtoms may include redness, itching, pain, and possible dermal blistering or burns. It may be absorbed through the skin with possible systemic effects. A single prolonged skin exposure is not likely to result in the material being absorbed in harmful amounts. Eyes: Contact causes transient eye irritation, lacrimation. Vapors cause eye/conjunctival irritation. Symptoms may include redness and pain. Inhalation: The main route to occupational exposure is by inhalation since it is readily absorbed through the lungs. It causes respiratory tract irritation, . It can affect behavior/central nervous system (CNS depressant and anesthesia ranging from slight inebriation to death, vertigo, somnolence, anxiety, headache, excitement, hallucinations, muscle incoordination, dizziness, lightheadness, disorentiation, seizures, enotional instability, stupor, coma). It may cause pulmonary edema Ingestion: It can cause nausea, vomiting, anorexia, diarrhea, bloody stool. It may affect the liver, urinary system (proteinuria, hematuria, renal failure, renal tubular disorder), heart (arrhythmias). It may affect behavior/central nervous system with symptoms similar to that of inhalation. Chronic Potential Health Effects: Skin: Prolonged or repeated skin contact may result in excessive drying of the skin, and irritation. Ingestion/Inhalation: Chronic exposure can affect the liver(hepatitis,fatty liver degeneration), kidneys, spleen, and heart (irregular heartbeat/arrhythmias, cardiomyopathy, abnormal EEG), brain, behavior/ central nervous system/peripheral nervous system (impaired memory, numbness of extremeties, peripheral neuropathy and other

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 18.4 mg/l 96 hours [Fish (Fathead Minnow)]. 18 mg/l 48 hours [Daphnia (daphnia)]. 5 mg/l 96 hours [Fish (Rainbow Trout)]. 13 mg/l 96 hours [Fish (Bluegill sunfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Tetrachloroethylene UNNA: 1897 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Tetrachloroethylene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Tetrachloroethylene Connecticut hazardous material survey.: Tetrachloroethylene Illinois toxic substances disclosure to employee act: Tetrachloroethylene Illinois chemical safety act: Tetrachloroethylene New York release reporting list: Tetrachloroethylene Rhode Island RTK hazardous substances: Tetrachloroethylene Pennsylvania RTK: Tetrachloroethylene Minnesota: Tetrachloroethylene Michigan critical material: Tetrachloroethylene Massachusetts RTK: Tetrachloroethylene Massachusetts spill list: Tetrachloroethylene New Jersey: Tetrachloroethylene New Jersey spill list: Tetrachloroethylene Louisiana spill reporting: Tetrachloroethylene California Director's List of Hazardous Substances: Tetrachloroethylene TSCA 8(b) inventory: Tetrachloroethylene TSCA 8(d) H and S data reporting: Tetrachloroethylene: Effective date: 6/1/87; Sunset date: 6/1/97 SARA 313 toxic chemical notification and release reporting: Tetrachloroethylene CERCLA: Hazardous substances.: Tetrachloroethylene: 100 lbs. (45.36 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-1B: Material causing immediate and serious toxic effects (TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R40- Possible risks of irreversible effects. R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. S23- Do not breathe gas/fumes/vapour/spray S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S37- Wear suitable gloves. S61- Avoid release to the environment. Refer to special instructions/Safety data sheets.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 0

Reactivity: 0

Personal Protection: g

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Safety glasses.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 08:29 PM

Last Updated: 05/21/2013 12:00 PM

Manufactured for
INDUSTRIAL SCIENTIFIC CORPORATION
1001 Oakdale Road
Oakdale, PA 15071-1500
Phone (412) 788-4353
TOLL-FREE 800-DETECTS
Fax (412) 788-8353

MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS: NON-FLAMMABLE GAS MIXTURE

Containing One or More of the Following Components in a Nitrogen Balance Gas: Oxygen, 0.0015-23.5%; Propane, 0-1.1%; n-Pentane, 0-0.75%; n-Hexane; 0-0.48%; Carbon Monoxide, 0.0005-1.0%; Hydrogen Sulfide, 0.001-0.025%

NOTE: MIXTURES COMPRISED OF AN AIR BALANCE GAS CONTAIN BETWEEN 19.5-23.5% OXYGEN.

SYNONYMS: Not Applicable

CHEMICAL FAMILY NAME: Not Applicable

FORMULA: Not Applicable

Document Number: 50016 (Replaces ISC MSDS No.1810-2187, 1810-2343, 1810-3366, 1810-3937 1810-7219, 1810-7599, 1810-6179)

Note: The Material Safety Data Sheet is for this gas mixture supplied in cylinders with 33 cubic feet (935 liters) or less gas capacity (DOT - 39 cylinders). This MSDS has been developed for various gas mixtures with the composition of components within the ranges listed in Section 2 (Composition and Information on Ingredients). Refer to the product label for information on the actual composition of the product.

PRODUCT USE:	Calibration of Monitoring and Research Equipment
SUPPLIER/MANUFACTURER'S NAME:	CALGAZ
ADDRESS:	821 Chesapeake Drive Cambridge, MD 21613
EMERGENCY PHONE:	CHEMTREC: 1-800-424-9300
BUSINESS PHONE:	1-410-228-6400
General MSDS Information	1-713/868-0440
Fax on Demand:	1-800/231-1366

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	mole %	EXPOSURE LIMITS IN AIR					
			ACGIHTLV		OSHA		IDLH	OTHER
			TWA ppm	STEL ppm	TWA ppm	STEL ppm	ppm	ppm
Oxygen	7782-44-7	0.0015 - 23.5%	There are no specific exposure limits for Oxygen. Oxygen levels should be maintained above 19.5%.					
Propane	74-98-6	0 - 1.1%	2500	NE	1000	NE	2100	NIOSH REL: 1000 DFG MAK: 1000 ppm
n-Pentane	109-66-0	0 - 0.75%	600	750	1000 600 (Vacated 1989 PEL)	750 (Vacated 1989 PEL)	1500	NIOSH REL: TWA = 120 STEL = 610 (ceiling) 15 minutes DFG MAKs: TWA =1000 PEAK = 2•MAK, 60 min., momentary value
n-Hexane	110-54-3	0 - 0.48%	50	NE	500 50 (Vacated 1989 PEL)	NE	1100	NIOSH REL: 50 DFG MAK: 50
Hydrogen Sulfide	7783-06-4	0.001-0.025 %	10 NIC = 5	15 NIC = 5	10 (Vacated 1989 PEL)	20 (ceiling), 50 (10 min. peak, once per shift) 15 (Vacated 1989 PEL)	100	NIOSH REL: STEL = 10 (ceiling), 10 minutes DFG MAKs: TWA = 10 PEAK = 2•MAK, 10 min., momentary value
Carbon Monoxide	630-08-0	0.0005 - 1.0%	25	NE	50 35 (Vacated 1989 PEL)	200 (ceiling) (Vacated 1989 PEL)	1200	NIOSH RELs: TWA = 35 STEL = 200 ceiling DFG MAKs: TWA = 30 PEAK = 2•MAK, 15 min., average value, 1 hr interval DFG MAK Pregnancy Risk Classification: B
Nitrogen	7727-37-9	Balance	There are no specific exposure limits for Nitrogen. Nitrogen is a simple asphyxiant (SA). Oxygen levels should be maintained above 19.5%.					

NE = Not Established. NIC = Notice of Intended Change See Section 16 for Definitions of Terms Used.

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. This gas mixture has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: This gas mixture is a colorless gas which has a rotten-egg odor (due to the presence of Hydrogen Sulfide). The odor cannot be relied on as an adequate warning of the presence of this gas mixture, because olfactory fatigue occurs after over-exposure to Hydrogen Sulfide. Hydrogen Sulfide and Carbon Monoxide (another component of this gas mixture) are toxic to humans in relatively low concentrations. Over-exposure to this gas mixture can cause skin or eye irritation, nausea, dizziness, headaches, collapse, unconsciousness, coma, and death. The Propane, n-Pentane, and n-Hexane components can cause anesthetic or peripheral neuropathy effects. Additionally, releases of this gas mixture may produce oxygen-deficient atmospheres (especially in small confined spaces or other poorly-ventilated environments); individuals in such atmospheres may be asphyxiated.

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH HAZARD	(BLUE)	3
FLAMMABILITY HAZARD	(RED)	0
PHYSICAL HAZARD	(YELLOW)	0

PROTECTIVE EQUIPMENT

EYES	RESPIRATORY	HANDS	BODY
See Section 8			

For Routine Industrial Use and Handling Applications

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant route of over-exposure for this gas mixture is by inhalation.

INHALATION: Due to the small size of an individual cylinder of this gas mixture, no unusual health effects from over-exposure to the product are anticipated under routine circumstances of use. A significant health hazard associated with this gas mixture is the potential of inhalation of Hydrogen Sulfide, a component of this gas mixture. Such over-exposures may occur if this gas mixture is used in a confined space or other poorly-ventilated area. Over-exposures to Hydrogen Sulfide can cause dizziness, headache, and nausea. Exposure to this component can result in respiratory arrest, coma, or unconsciousness. Continuous inhalation of low concentrations of Hydrogen Sulfide may cause olfactory fatigue, so that the odor is no longer an effective warning of the presence of this gas. A summary of exposure concentrations and observed effects are as follows

CONCENTRATION OF HYDROGEN SULFIDE	OBSERVED EFFECT
0.3-30 ppm	Odor is obvious and unpleasant.
50 ppm	Eye irritation. Dryness and irritation of nose, throat.
Slightly higher than 50 ppm	Irritation of the respiratory system.
100-150 ppm	Temporary loss of smell.
200-250 ppm	Headache, vomiting nausea. Prolonged exposure may lead to lung damage. Exposures of 4-8 hours can be fatal.
300-500	Swifter onset of symptoms. Death occurs in 1-4 hours.
500 ppm	Headache, excitement, staggering, and stomach ache after brief exposure. Death occurs within 0.5 - 1 hour of exposure.
> 600 ppm	Rapid onset of unconsciousness, coma, death.
> 1000 ppm	Immediate respiratory arrest.
NOTE:	This gas mixture contains a maximum of 250 ppm Hydrogen Sulfide. The higher concentration values here are presented to delineate the complete health effects which have been observed for humans after exposure to Hydrogen Sulfide.

Inhalation over-exposures to atmospheres containing more than the Threshold Limit Value of Carbon Monoxide (25 ppm), another component of this gas mixture, can result in serious health consequences. Carbon Monoxide is classified as a chemical asphyxiant, producing a toxic action by combining with the hemoglobin of the blood and replacing the available oxygen. Through this replacement, the body is deprived of the required oxygen, and asphyxiation occurs.

Since the affinity of Carbon Monoxide for hemoglobin is about 200-300 times that of oxygen, only a small amount of Carbon Monoxide will cause a toxic reaction to occur. Carbon Monoxide exposures in excess of 50 ppm will produce symptoms of poisoning if breathed for a sufficiently long time. If this gas mixture is released in a small, poorly ventilated area (i.e. an enclosed or confined space), symptoms which may develop include the following:

CONCENTRATION OF CARBON MONOXIDE	OBSERVED EFFECT
All exposure levels: ..	Over-exposure to Carbon Monoxide can be indicated by the lips and fingernails turning bright red.
200 ppm:	Slight symptoms (i.e. headache) after several hours of exposure.
400 ppm:	Headache and discomfort experienced within 2-3 hours of exposure.
1,000 -2000 ppm:	Within 30 minutes, slight palpitations of the heart occurs. Within 1.5 hours, there is a tendency to stagger.
200-2500 ppm:	Within 2 hours, there is mental confusion, headaches, and nausea. Unconsciousness within 30 minutes.
> 2500 ppm:	Potential for collapse and death before warning symptoms.

Another hazard associated with this gas mixture is the potential for anesthetic and peripheral neuropathy effects after inhalation over-exposures to the Propane, n-Pentane and n-Hexane components of this gas mixture. Specific human over-exposure data are available for n-Pentane and n-Hexane, as follows:

CONCENTRATION OF n-PENTANE	OBSERVED EFFECT
Brief (10 minute) up to 5,000 ppm:	No symptoms.
Higher than 5,000 ppm:	Exhilaration, dizziness and headache can occur.
Long term:	Can cause chronic neurological disorder causing damage to the nerves in the hands and feet (peripheral neuropathy)

CONCENTRATION OF n-HEXANE	OBSERVED EFFECT
Brief (10 minute) at 1,500 ppm:	Irritation of the respiratory tract, nausea and headache.
5000 ppm:	Dizziness and drowsiness can occur.
Long term at 500 ppm:	Can affect the nerves in the arms and legs. Effects include numbing or tingling sensations in the fingers and toes, tiredness, muscle weakness, cramps and spasms in the leg, difficulty in holding objects or walking, abdominal pains, loss of appetite, weight loss. More serious exposures can cause damage to the nerves in the hands and feet (peripheral neuropathy).
Eyes and Vision:	Abnormal color perception and pigment changes in the eyes have been reported among industrial workers exposed to 423-1280 ppm for 5 years or more.
Blood Cells:	Mild forms of anemia have also been associated with exposure to hexane. These are of temporary nature.

Additionally, if mixtures of this gas mixture contain less than 19.5% Oxygen and are released in a small, poorly ventilated area (i.e. an enclosed or confined space), an oxygen-deficient environment may occur. Individuals breathing such an atmosphere may experience symptoms which include headaches, ringing in ears, dizziness, drowsiness, unconsciousness, nausea, vomiting, and depression of all the senses. Under some circumstances of over-exposure, death may occur. The following effects associated with various levels of oxygen are as follows:

CONCENTRATION OF OXYGEN	OBSERVED EFFECT
12-16% Oxygen:	Breathing and pulse rate increased, muscular coordination slightly disturbed.
10-14% Oxygen:	Emotional upset, abnormal fatigue, disturbed respiration.
6-10% Oxygen:	Nausea, vomiting, collapse, or loss of consciousness.
Below 6%:	Convulsive movements, possible respiratory collapse, and death.

SKIN and EYE CONTACT: The Hydrogen Sulfide component of this gas mixture may be irritating to the skin. Inflammation and irritation of the eyes can occur at very low airborne concentration of Hydrogen Sulfide (less than 10 ppm). Exposure over several hours may result in "gas eyes" or "sore eyes" with symptoms of scratchiness, irritation, tearing and burning. Above 50 ppm of Hydrogen Sulfide, there is an intense tearing, blurring of vision, and pain when looking at light. Over-exposed individuals may see rings around bright lights. Most symptoms disappear when exposure ceases. However, in serious cases, the eye can be permanently damaged.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in Lay Terms. Over-exposure to this gas mixture may cause the following health effects:

ACUTE: Due to the small size of the individual cylinder of this gas mixture, no unusual health effects from exposure to the product are anticipated under routine circumstances of use. However, the Hydrogen Sulfide and Carbon Monoxide components of this gas mixture are toxic to humans. Over-exposure to this gas mixture can cause nausea, dizziness, headaches, collapse, unconsciousness, coma, and death. Due to the presence of Hydrogen Sulfide, over-exposures to this gas mixture can also irritate the skin and eyes; severe eye contamination can result in blindness.

Inhalation over-exposures to Propane, n-Pentane, and n-Hexane can cause anesthetic effects and motor neuropathy (i.e. pain and tingling in feet and hands).

3. HAZARD IDENTIFICATION (Continued)

CHRONIC: Abnormal color perception and pigment changes in the eyes have been reported among persons exposed to 420 -1300 ppm of n-Hexane for five years. Additionally, long-term exposure to low levels of n-Hexane or n-Pentane can affect the nerves in the arms and legs. Effects include numbing or tingling sensation, tiredness, cramps, spasms in legs, difficulty holding objects or walking, loss of appetite and weight loss. Pentane isomers, such as n-Pentane, and Propane can cause sensitization of the heart to epinephrine. Refer to Section 11 (Toxicology Information) for additional information on the components of this gas mixture.

TARGET ORGANS: ACUTE: Respiratory system, blood system, central nervous system, cardiovascular system. CHRONIC: Reproductive system, cardiovascular system.

4. FIRST-AID MEASURES

RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO THIS GAS MIXTURE WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn.

No unusual health effects are anticipated after exposure to this gas mixture, due to the small cylinder size. If any adverse symptom develops after over-exposure to this gas mixture, remove victim(s) to fresh air as quickly as possible. Only trained personnel should administer supplemental oxygen and/or cardio-pulmonary resuscitation if necessary.

Victim(s) who experience any adverse effect after over-exposure to this gas mixture must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

SKIN EXPOSURE: If irritation of the skin develops after exposure to this gas mixture, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. Victim must seek immediate medical attention.

EYE EXPOSURE: If irritation of the eye develops after exposure to this gas mixture, open victim's eyes while under gentle running water. Use sufficient force to open eyelids. Have victim "roll" eyes. Minimum flushing is for 15 minutes. Seek medical assistance immediately, preferably an ophthalmologist.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing respiratory conditions may be aggravated by over-exposure to this gas mixture. Carbon Monoxide, a component of this gas mixture, can aggravate some diseases of the cardiovascular system, such as coronary artery disease and angina pectoris. Because of the presence of Hydrogen Sulfide, n-Hexane or n-Pentane in this gas mixture, central nervous system conditions, eye disorders, or skin problems may be aggravated by over-exposure to this gas mixture.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and eliminate over-exposure. Hyperbaric oxygen is the most efficient antidote to Carbon Monoxide poisoning, the optimum range being 2-2.5 atm. A special mask, or, preferably, a compression chamber to utilize oxygen at these pressures is required. Avoid administering stimulant drugs. Be observant for initial signs of pulmonary edema in the event of severe inhalation over-exposures.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not applicable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): Not applicable.
Upper (UEL): Not applicable.

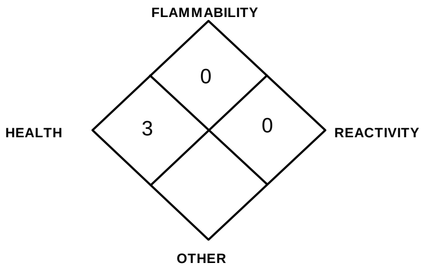
FIRE EXTINGUISHING MATERIALS: Non-flammable gas mixture. Use extinguishing media appropriate for surrounding fire.

UNUSUAL FIRE AND EXPLOSION HAZARDS: This gas mixture contains toxic gases, Hydrogen Sulfide and Carbon Monoxide, and presents an extreme health hazard to firefighters. This gas mixture is not flammable; however, containers, when involved in fire, may rupture or burst in the heat of the fire.

Explosion Sensitivity to Mechanical Impact: Not Sensitive.
Explosion Sensitivity to Static Discharge: Not Sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment.

NFPA RATING



6. ACCIDENTAL RELEASE MEASURES

LEAK RESPONSE: Due to the small size and content of the cylinder, an accidental release of this gas mixture presents significantly less risk of over-exposure to Hydrogen Sulfide and Carbon Monoxide, the toxic components of this gas mixture, and other safety hazards related to the remaining components of this gas mixture, than a similar release from a larger cylinder. However, as with any chemical release, extreme caution must be used during emergency response procedures. In the event of a release in which the atmosphere is unknown, and in which other chemicals are potentially involved, evacuate immediate area. Such releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a leak, clear the affected area, protect people, and respond with trained personnel.

For emergency disposal, secure the cylinder and slowly discharge the gas to the atmosphere in a well-ventilated area or outdoors. Allow the gas mixture to dissipate. If necessary, monitor the surrounding area (and the original area of the release) for Hydrogen Sulfide, Carbon Monoxide, and Oxygen. Hydrogen Sulfide and Carbon Monoxide level must be below exposure level listed in Section 2 (Composition and Information on Ingredients) and Oxygen levels must be above 19.5% before non-emergency personnel are allowed to re-enter area.

If leaking incidentally from the cylinder, contact your supplier.

7. HANDLING and USE

WORK PRACTICES AND HYGIENE PRACTICES: Be aware of any signs of dizziness or fatigue; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms, due to olfactory fatigue or oxygen deficiency. Do not attempt to repair, adjust, or in any other way modify cylinders containing a gas mixture with Hydrogen Sulfide or Carbon Monoxide. If there is a malfunction or another type of operational problem, contact nearest distributor immediately. Eye wash stations/safety showers should be near areas where this gas mixture is used or stored. All work operations should be monitored in such a way that emergency personnel can be immediately contacted in the event of a release. All work practices should minimize releases of Hydrogen Sulfide and Carbon Monoxide-containing gas mixtures.

STORAGE AND HANDLING PRACTICES: Cylinders should be firmly secured to prevent falling or being knocked-over. Cylinders must be protected from the environment, and preferably kept at room temperature (approximately 21°C, 70°F). Cylinders should be stored in dry, well-ventilated areas, away from sources of heat, ignition, and direct sunlight. Protect cylinders against physical damage.

Full and empty cylinders should be segregated. Use a first-in, first-out inventory system to prevent full containers from being stored for long periods of time. These cylinders are not refillable. **WARNING! Do not refill DOT 39 cylinders. To do so may cause personal injury or property damage.**

SPECIAL PRECAUTIONS FOR HANDLING GAS CYLINDERS: WARNING! Compressed gases can present significant safety hazards. During cylinder use, use equipment designed for these specific cylinders. Ensure all lines and equipment are rated for proper service pressure.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use product in areas where adequate ventilation is provided.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: No special ventilation systems or engineering controls are needed under normal circumstances of use. As with all chemicals, use this gas mixture in well-ventilated areas. If this gas mixture is used in a poorly-ventilated area, install automatic monitoring equipment to detect the levels of Oxygen, Hydrogen Sulfide, and Carbon Monoxide.

RESPIRATORY PROTECTION: No special respiratory protection is required under normal circumstances of use. Use supplied air respiratory protection if Carbon Monoxide levels exceed the exposure levels given in Section 2 (Composition and Information on Ingredients) or if oxygen levels are below 19.5%, or if either level is unknown during emergency response to a release of this gas mixture. If respiratory protection is required for emergency response to this gas mixture, follow the requirements of the Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent State standards. The following NIOSH respiratory protection recommendations for Hydrogen Sulfide and Carbon Monoxide are provided for further information.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION (Continued)

NIOSH/OSHA RECOMMENDATIONS FOR HYDROGEN SULFIDE CONCENTRATIONS IN AIR:

Up to 100 ppm: Powered air-purifying respirator with cartridge(s) to protect against hydrogen sulfide; or gas mask with canister to protect against hydrogen sulfide; or SAR; or full-facepiece SCBA.
Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
Escape: Gas mask with canister to protect against hydrogen sulfide; or escape-type SCBA
NOTE: The IDLH concentration for Hydrogen Sulfide is 100 ppm.

NIOSH/OSHA RECOMMENDATIONS FOR CARBON MONOXIDE CONCENTRATIONS IN AIR:

Up to 350 ppm Supplied Air Respirator (SAR)
Up to 875 ppm Supplied Air Respirator (SAR) operated in a continuous flow mode.
Up to 1200 ppm Gas mask with canister to protect against carbon monoxide; or full-facepiece SCBA; or full-facepiece Supplied Air Respirator (SAR).
Emergency or Planned Entry into Unknown Concentration or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece Supplied Air Respirator (SAR) with an auxiliary positive pressure SCBA.
Escape: Gas mask with canister to protect against carbon monoxide; or escape-type SCBA.
NOTE: End of Service Life Indicator (ESLI) required for gas masks.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: No special protection is needed under normal circumstances of use. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: No special protection is needed under normal circumstances of use. If a hazard of injury to the feet exists due to falling objects, rolling objects, where objects may pierce the soles of the feet or where employee's feet may be exposed to electrical hazards, use foot protection, as described in U.S. OSHA 29 CFR 1910.136.

9. PHYSICAL and CHEMICAL PROPERTIES

The following information is for Nitrogen, the main component of this gas mixture.

GAS DENSITY @ 32°F (0°C) and 1 atm: 0.072 lbs/ ft^3 (1.153 kg/m^3)
FREEZING/MELTING POINT @ 10 psig: -210°C (-345.8°F)
SPECIFIC GRAVITY (air = 1) @ 70°F (21.1°C): 0.906
SOLUBILITY IN WATER vol/vol @ 32°F (0°C) and 1 atm: 0.023
EVAPORATION RATE (nBuAc = 1): Not applicable.
ODOR THRESHOLD: Not applicable.
VAPOR PRESSURE @ 70°F (21.1°C) psig: Not applicable.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.
BOILING POINT: -195.8°C (-320.4°F)
pH: Not applicable.
MOLECULAR WEIGHT: 28.01
EXPANSION RATIO: Not applicable.
SPECIFIC VOLUME (ft^3/lb): 13.8

The following information is for the gas mixture.

APPEARANCE AND COLOR: This gas mixture is a colorless gas which has an rotten egg-like odor, due to the presence of Hydrogen Sulfide.

HOW TO DETECT THIS SUBSTANCE (warning properties): Continuous inhalation of low concentrations of Hydrogen Sulfide (a component of this gas mixture) may cause olfactory fatigue, so that there are no distinct warning properties. In terms of leak detection, fittings and joints can be painted with a soap solution to detect leaks, which will be indicated by a bubble formation. Wet lead acetate paper can be used for leak detection. The paper turns black in the presence of Hydrogen Sulfide. Cadmium chloride solutions can also be used. Cadmium solutions will turn yellow upon contact with Hydrogen Sulfide.

10. STABILITY and REACTIVITY

STABILITY: Normally stable in gaseous state.

DECOMPOSITION PRODUCTS: The thermal decomposition products of Propane, n-Hexane, and n-Pentane include carbon oxides. The decomposition products of Hydrogen Sulfide include water and sulfur oxides. The other components of this gas mixture do not decompose, per se, but can react with other compounds in the heat of a fire.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Titanium will burn in Nitrogen (the main component of this gas mixture). Lithium reacts slowly with Nitrogen at ambient temperatures. Components of this gas mixture (Hydrogen Sulfide, Propane, n-Pentane, n-Hexane) are also incompatible with strong oxidizers (i.e. chlorine, bromine pentafluoride, oxygen, oxygen difluoride, and nitrogen trifluoride). Carbon Monoxide is mildly corrosive to nickel and iron (especially at high temperatures and pressures). Hydrogen Sulfide is corrosive to most metals, because it reacts with these substances to form metal sulfides.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials. Cylinders exposed to high temperatures or direct flame can rupture or burst.

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following toxicology data are available for the components of this gas mixture:

NITROGEN: There are no specific toxicology data for Nitrogen. Nitrogen is a simple asphyxiant, which acts to displace oxygen in the

n-PENTANE:
LD_{50} (intravenous, mouse) = 446 mg/kg.
LC_{50} (inhalation, rat) = 364 g/m^3/4 hours
LCLo (inhalation, mouse) = 325 g/m^3/2 hours

n-HEXANE:
Eye, rabbit = 10 mg/ mild
TCLo (inhalation, rat) = 10,000 ppm/7 hr.
TCLo (inhalation, rat) = 5000 ppm/20 hours; teratogenic effects
LD50 (oral, rat) = 28710 mg/kg
LDLo (intraperitoneal, rat) = 9100 mg/kg
LCLo (inhalation, mouse) = 120,000 mg/kg
LD50 (rat, oral): 28,710 mg/kg
ACUTE INHALATION (mouse): 30,000 ppm, narcosis within 30 to 60 minutes; 35,000-40,000 ppm, convulsions and death.
DERMAL (rabbit): 2 to 5 ml/kg for 4 hours resulted in restlessness and discoordination,; death occurred at 5 ml/kg.

n-HEXANE (continued):
CHRONIC INHALATION (rat): 400-600 ppm, 5 days/week, peripheral neuropathy in 45 days; 850 ppm for 143 days, loss of weight and degeneration of the sciatic nerve. (mouse): 250 ppm, peripheral neuropathy within 7 months; no effects at 100 ppm.

PROPANE:
Long-Term Inhalation: No toxicity or abnormalities were observed when monkeys were exposed to approximately 750 ppm for 90 days. Similar results were obtained when monkeys were exposed to an aerosol spray containing 65% propane and isobutane.

CARBON MONOXIDE:
TCLo (inhalation, mouse) = 65 ppm/24 hours (7-18 preg): rep. effects
TCLo (inhalation, mouse) = 8 pph/1 hour (female 8D post): ter. effects

CARBON MONOXIDE (continued):
TCLo (inhalation, human) = 600 mg/m^3/10 minutes
LCLo (inhalation, man) = 4000 ppm/30 minutes
TCLo (inhalation, man) = 650 ppm/45 minutes: central nervous system and blood system effects.
LCLo (inhalation, human) = 5000 ppm/5 minutes
LCLo (inhalation, dog) = 4000 ppm/46 minutes
LCLo (inhalation, rabbit) = 4000 ppm
LC_{50} (inhalation, rat) = 1811 ppm/4 hours
LC_{50} (inhalation, guinea pig) = 2450 ppm/4 hours
LC_{50} (inhalation, guinea pig) = 5718 ppm/4 hours
LCLo (inhalation, mammal) = 5000 ppm/5 minutes
LD_{50} (inhalation, wild bird) = 1334 ppm

HYDROGEN SULFIDE:
LCLo (inhalation, human) = 600 ppm/30 minutes
LDLO (inhalation, man) = 5.7 mg/kg; central nervous system, pulmonary effects

HYDROGEN SULFIDE (continued):
LCLo (inhalation, human) = 800 ppm/5 minutes
LC_{50} (inhalation, rat) = 444 ppm

HYDROGEN SULFIDE (continued):
LC_{50} (inhalation, mouse) = 673 ppm/1 hour
LCLo (inhalation, mammal) = 800 ppm/5 minutes

SUSPECTED CANCER AGENT: The components of this gas mixture are not found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, and IARC; therefore, they are not considered to be, nor suspected to be, cancer-causing agents by these agencies.

IRRITANCY OF PRODUCT: The Hydrogen Sulfide component of this gas mixture, is irritating to the eyes, and may be irritating to the skin.

SENSITIZATION OF PRODUCT: The components of this gas mixture are not known to be skin or respiratory sensitizers. Pentane isomers (i.e. n-Pentane) and Propane can cause cardiac sensitization to epinephrine.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of this gas mixture on the human reproductive system.

Mutagenicity: No mutagenicity effects have been described for the components of this gas mixture.

Embryotoxicity: This gas mixture contains components that may cause embryotoxic effects in humans; however, due to the small total amount of the components, embryotoxic effects are not expected to occur.

Teratogenicity: This gas mixture is not expected to cause teratogenic effects in humans due to the small cylinder size and small total amount of all components. The Carbon Monoxide component of this gas mixture which exists up to 1%, can cause teratogenic effects in humans. Severe

11. TOXICOLOGICAL INFORMATION (continued)

exposure to Carbon Monoxide during pregnancy has caused adverse effects and the death of the fetus. In general, maternal symptoms are an indicator of the potential risk to the fetus since Carbon Monoxide is toxic to the mother before it is toxic to the fetus.

Reproductive Toxicity: The components of this gas mixture are not expected to cause adverse reproductive effects in humans.

A mutagen is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generation lines. An embryotoxin is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A teratogen is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A reproductive toxin is any substance which interferes in any way with the reproductive process.

BIOLOGICAL EXPOSURE INDICES (BEIs): Biological Exposure Indices (BEIs) have been determined for the components of this gas mixture, as follows:

CHEMICAL DETERMINANT	SAMPLING TIME	BEI
CARBON MONOXIDE • Carboxyhemoglobin in blood • Carbon monoxide in end-exhaled air	• End of shift • End of shift	• 3.5% of hemoglobin • 20 ppm
n-HEXANE • 2,5-Hexanedione in urine • n-Hexane in end-exhaled air	• End of shift	• 5 mg/g creatinine

12. ECOLOGICAL INFORMATION

ENVIRONMENTAL STABILITY: The gas will be dissipated rapidly in well-ventilated areas. The following environmental data are applicable to the components of this gas mixture.

OXYGEN: Water Solubility = 1 volume Oxygen/32 volumes water at 20°C. Log K_{ow} = -0.65

PROPANE: Log K_{ow} = 2.38. Water Solubility = 62.4 ppm, 25°C. Propane is readily degraded by soil bacteria.

PENTANE: Log K_{ow} = 3.39. Water Solubility = 38.5 mg/L. LOG BCF (n-pentane) = calculated, 1.90 and 2.35, respectively. Photolysis, hydrolysis, and bioconcentration are not anticipated to be important fate processes. Biodegradation and soil adsorption are anticipated to be more important processes for this compound.

n-HEXANE: Log K_{ow} = 3.90-4.11. Water Solubility = 9.5 mg/L. Estimated Bioconcentration Factor =2.24 and 2.89. Bioconcentration in aquatic organisms is low. Hexane is volatile. Rapid volatilization from water and soil is anticipated for this compound. Hexane will float in slick on surface of the water

HYDROGEN SULFIDE: Water Solubility = 1 g/242 mL at 20°C.

CARBON MONOXIDE: Water solubility = 3.3 ml/100 cc at 0 °C, 2.3 ml at 20°C.

NITROGEN: Water Solubility = 2.4 volumes Nitrogen/100 volumes water at 0°C; 1.6 volumes Nitrogen/100 volumes water at 20°C.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this gas mixture's effects on plant and animal life. The Hydrogen Sulfide and Carbon Monoxide components of this gas mixture, can be deadly to exposed animal life, producing symptoms similar to those experienced by humans. This gas mixture may also be harmful to plant life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on the effects of this gas effects on aquatic life. The presence of more than a trace of Carbon Monoxide is a hazard to fish. The following aquatic toxicity data are available for the Hydrogen Sulfide component of this gas mixture.

TLm (Asellussp) = 0.111 mg/L/96 hour
TLm (Cranfgonyx sp) =1.07 mg/L/96 hour
TLm (Gammarrus) = 0.84 mg/L/96 hour
LC_{50} (fly inhalation) = 380 mg/m^3/960 minutes
LC_{50} (fly inhalation) = 1500 mg/m^3/7 minutes
TLm (Lepomis macrochirus, bluegill sunfish) = 0.0478 mg/L/96 hour
TLm (Lepomis macrochirus, bluegill sunfish) = 0.0448 mg/L/96 hour at 21-22 °C
TLm (Pimephlaes promelas, fathead minnow) = 0.0071-0.55 mg/L/96 hour
TLm (Salvenilis foninalis, brook trout) = 0.0216-0.038 mg/L/96 hour at 8-12.5 °C

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. Cylinders with undesired residual product may be safely vented outdoors with the proper regulator. For further information, refer to Section 16 (Other Information).

14. TRANSPORTATION INFORMATION

THIS GAS MIXTURE IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (*Oxygen, Nitrogen)*or the gas component with the next highest concentration next to Nitrogen.

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
PACKING GROUP: Not Applicable
DOT LABEL(S) REQUIRED: Class 2.2 (Non-Flammable Gas)
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126

MARINE POLLUTANT: The components of this gas mixture are not classified by the DOT as Marine Pollutants (as defined by 49 CFR 172.101, Appendix B).

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

Note: DOT 39 Cylinders ship in a strong outer carton (overpack). Pertinent shipping information goes on the outside of the overpack. DOT 39 Cylinders do not have transportation information on the cylinder itself.

TRANSPORT CANADA TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This gas is considered as Dangerous Goods, per regulations of Transport Canada.

PROPER SHIPPING NAME: Compressed gases, n.o.s. (*Oxygen, Nitrogen)*or the gas component with the next highest concentration next to Nitrogen.

HAZARD CLASS NUMBER and DESCRIPTION: 2.2 (Non-Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1956
PACKING GROUP: Not Applicable
HAZARD LABEL: Class 2.2 (Non-Flammable Gas)
SPECIAL PROVISIONS: None
EXPLOSIVE LIMIT AND LIMITED QUANTITY INDEX: 0.12
ERAP INDEX: None
PASSENGER CARRYING SHIP INDEX: None
PASSENGER CARRYING ROAD VEHICLE OR PASSENGER CARRYING RAILWAY VEHICLE INDEX: 75
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2000): 126

NOTE: Shipment of compressed gas cylinders via Public Passenger Road Vehicle is a violation of Canadian law (Transport Canada Transportation of Dangerous Goods Act, 1992).

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: This gas is not subject to the reporting requirements of Sections 302, 304 and 313 of Title III of the Superfund Amendments and Reauthorization Act., as follows:

COMPONENT	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
n-Hexane	NO	YES	YES
Hydrogen Sulfide	YES	YES	YES

15. REGULATORY INFORMATION (Continued)

U.S. SARA THRESHOLD PLANNING QUANTITY: Section 302 EHS TPQ = Hydrogen Sulfide = 500 lbs (227 kg);
U.S. TSCA INVENTORY STATUS: The components of this gas mixture are listed on the TSCA Inventory.
U.S. CERCLA REPORTABLE QUANTITY (RQ): Hexane = 5000 lb (2270 kg); Hydrogen Sulfide = 100 lbs (45.4 lb)
OTHER U.S. FEDERAL REGULATIONS:

- Hydrogen Sulfide, Carbon Monoxide, Propane, n-Pentane and n-Hexane are subject to the reporting requirements of CFR 29 1910.1000.
- Hydrogen Sulfide, Propane and n-Pentane are subject to the reporting requirements of Section 112(r) of the Clean Air Act. The Threshold Quantity for each of these gases is 10,000 pounds and so this mixture will not be affected by the regulation.
- Depending on specific operations involving the use of this gas mixture, the regulations of the Process Safety Management of Highly Hazardous Chemicals may be applicable (29 CFR 1910.119). Hydrogen Sulfide is listed in Appendix A of this regulation. The Threshold Quantity for Hydrogen Sulfide under this regulation is 1500 lbs.
- This gas mixture does not contain any Class I or Class II ozone depleting chemicals (40 CFR part 82).
- Nitrogen, Oxygen and n-Hexane are not listed Regulated Substances, per 40 CFR, Part 68, of the Risk Management for Chemical Releases. Hydrogen Sulfide is listed under this regulation in Table 1 as a Regulated Substance (Toxic Substance), in quantities of 10,000 lbs (4,553 kg) or greater. Carbon Monoxide, Propane and n-Pentane are listed under this regulation in Table 3, as Regulated Substances (Flammable), in quantities of 10,000 lbs (4,553 kg) or greater, and so this mixture will not be affected by the regulation.

U.S. STATE REGULATORY INFORMATION: The components of this gas mixture are covered under the following specific State regulations:

Alaska - Designated Toxic and Hazardous Substances: Carbon Monoxide, Propane, n-Pentane, n-Hexane, Hydrogen Sulfide.
California - Permissible Exposure Limits for Chemical Contaminants: Carbon Monoxide, Nitrogen, Propane, n-Pentane, n-Hexane, Hydrogen Sulfide.
Florida - Substance List: Oxygen, Carbon Monoxide, n-Pentane, n-Hexane, Hydrogen Sulfide.
Illinois - Toxic Substance List: Carbon Monoxide, Propane, n-Pentane, n-Hexane, Hydrogen Sulfide.
Kansas - Section 302/313 List: No.
Massachusetts - Substance List: Oxygen, Carbon Monoxide, Propane, n-Pentane, n-Hexane, Hydrogen Sulfide.
Michigan - Critical Materials Register: No.
Minnesota - List of Hazardous Substances: Carbon Monoxide, Propane, n-Pentane, n-Hexane, Hydrogen Sulfide.
Missouri - Employer Information/Toxic Substance List t: n-Pentane, n-Hexane, Propane, Hydrogen Sulfide.
New Jersey - Right to Know Hazardous Substance List: Oxygen, Carbon Monoxide, Nitrogen, Propane, n-Pentane, n-Hexane.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: Hydrogen Sulfide.
Pennsylvania - Hazardous Substance List: Oxygen, Carbon Monoxide, Nitrogen, Propane, n-Pentane, n-Hexane, Hydrogen Sulfide.
Rhode Island - Hazardous Substance List: Oxygen, Carbon Monoxide, Nitrogen, Propane, n-Pentane, n-Hexane, Hydrogen Sulfide.
Texas - Hazardous Substance List: n-Pentane, n-Hexane, Propane, Hydrogen Sulfide.
West Virginia - Hazardous Substance List: n-Pentane, n-Hexane, Propane, Hydrogen Sulfide.
Wisconsin - Toxic and Hazardous Substances: n-Pentane, n-Hexane, Propane, Hydrogen Sulfide

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): The Carbon Monoxide component of this gas mixture is on the California Proposition 65 lists as a chemical known to the State of California to cause birth defects or other reproductive harm.
ADDITIONAL CANADIAN REGULATIONS:

CANADIAN DSL/NDSL INVENTORY STATUS: The components of this gas mixture are on the Canadian DSL Inventory.
CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: The components of this gas mixture are not on the CEPA Priorities Substances List.
CANADIAN WHMIS CLASSIFICATION: This gas mixture is categorized as a Controlled Product, Hazard Classes A and D2A, as per the Controlled Product Regulations.

16. OTHER INFORMATION

INFORMATION ABOUT DOT-39 NRC (Non-Refillable Cylinder) PRODUCTS

DOT 39 cylinders ship as hazardous materials when full. Once the cylinders are relieved of pressure (empty) they are not considered hazardous material or waste. Residual gas in this type of cylinder is not an issue because toxic gas mixtures are prohibited. Calibration gas mixtures typically packaged in these cylinders are Nonflammable n.o.s., UN 1956. A small percentage of calibration gases packaged in DOT 39 cylinders are flammable or oxidizing gas mixtures.

For disposal of used DOT-39 cylinders, it is acceptable to place them in a landfill if local laws permit. Their disposal is no different than that employed with other DOT containers such as spray paint cans, household aerosols, or disposable cylinders of propane (for camping, torch etc.). When feasible, we recommended recycling for scrap metal content. CALGAZ will do this for any customer that wishes to return cylinders to us prepaid. All that is required is a phone call to make arrangements so we may anticipate arrival. Scrapping cylinders involves some preparation before the metal dealer may accept them. We perform this operation as a service to valued customers who want to participate.

MIXTURES: When two or more gases or liquefied gases are mixed, their hazardous properties may combine to create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an Industrial Hygienist or other trained person when you make your safety evaluation of the end product. Remember, gases and liquids have properties which can cause serious injury or death.

Further information about the handling of compressed gases can be found in the following pamphlets published by: Compressed Gas Association Inc. (CGA), 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202-4102. Telephone: (703) 412-0900.

P-1	*"Safe Handling of Compressed Gases in Containers"*
AV-1	*"Safe Handling and Storage of Compressed Gases"*
	"Handbook of Compressed Gases"

PREPARED BY:

CHEMICAL SAFETY ASSOCIATES, Inc.
PO Box 3519, La Mesa, CA 91944-3519
619/670-0609

Fax on Demand: 1-800/231-1366

AIR LIQUIDE

This Material Safety Data Sheet is offered pursuant to OSHA's Hazard Communication Standard, 29 CFR, 1910.1200. Other government regulations must be reviewed for applicability to this gas mixture. To the best of CALGAZ knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this gas mixture is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.

SAFETY DATA SHEET

1. Identification

Product identifier	**No.2 Fuel Oil**
Other means of identification	
SDS number	109-GHS
Synonyms	Fuel Oil No. 2, Home Heating Oil, X Grade Middle Distillate, Heating X-Grade Oil, Petroleum Distillate-Gas Oil & Light Gas Oil, Light Fuel Oil, Petroleum Distillate-Gas Oil #2 & #3 See section 16 for complete information.
Recommended use	Refinery feedstock.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer/Supplier	Valero Marketing & Supply Company and Affiliates One Valero Way San Antonio, TX 78269-6000
General Assistance	210-345-4593
E-Mail	CorpHSE@valero.com
Contact Person	Industrial Hygienist
Emergency Telephone	24 Hour Emergency 866-565-5220 1-800-424-9300 (CHEMTREC USA)

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 3
Health hazards	Germ cell mutagenicity	Category 1B
	Carcinogenicity	Category 1A
	Reproductive toxicity	Category 2
	Specific target organ toxicity, repeated exposure	Category 2
	Aspiration hazard	Category 1
Environmental hazards	Hazardous to the aquatic environment, long-term hazard	Category 2
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	Flammable liquid and vapor. May cause genetic defects. May cause cancer. Suspected of damaging fertility or the unborn child. May cause damage to organs (blood, liver, kidney) through prolonged or repeated exposure. May be fatal if swallowed and enters airways.
Precautionary statement	
Prevention	Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use only non-sparking tools. Take precautionary measures against static discharges. Wear protective gloves/protective clothing/eye protection/face protection. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not breathe dust/fume/gas/mist/vapors/spray. Wash thoroughly after handling.
Response	If on skin (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. If exposed or concerned: Get medical advice/attention. If swallowed: Immediately call a poison center/doctor.
Storage	Store in a well-ventilated place. Keep cool. Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Distillates petroleum residues vacuum	68955-27-1	90 - 100
n-Nonane	111-84-2	0 - 3
Cyclohexane	110-82-7	0 - 1
Ethylbenzene	100-41-4	0 - 1
Hexane (Other Isomers)	96-14-0	0 - 1
Hydrogen sulfide	7783-06-4	0 - 1
Naphthalene	91-20-3	0 - 1
Octane (all isomers)	111-65-9	0 - 1
Toluene	108-88-3	0 - 1
Xylene (o,m,p isomers)	1330-20-7	0 - 1
n-Heptane	142-82-5	0 - 1
n-Hexane	110-54-3	0 - 1
Benzene	71-43-2	0 - 0.5

Composition comments	Small amount of hydrogen sulfide, a highly toxic gas, may be present, especially in the headspace of containers.

4. First-aid measures

Inhalation	Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention if discomfort develops or persists.
Skin contact	Remove contaminated clothing and shoes. Wash off immediately with soap and plenty of water. Get medical attention if irritation develops or persists. Wash clothing separately before reuse. Destroy or thoroughly clean contaminated shoes.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention.
Ingestion	Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center. If vomiting occurs, keep head low so that stomach content does not get into the lungs. Never give anything by mouth to a victim who is unconscious or is having convulsions. Get medical attention immediately.
Most important symptoms/effects, acute and delayed	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Cyanosis (blue tissue condition, nails, lips, and/or skin). Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash.
Indication of immediate medical attention and special treatment needed	In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	If exposed or concerned: get medical attention/advice. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before re-use.

5. Fire-fighting measures

Suitable extinguishing media	Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use a solid water stream as it may scatter and spread fire.
Specific hazards arising from the chemical	Vapor may cause flash fire. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.

Special protective equipment and precautions for firefighters	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.
Fire-fighting equipment/instructions	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask. Withdraw immediately in case of rising sound from venting safety devices or any discoloration of tanks due to fire. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Move containers from fire area if you can do it without risk. In the event of fire, cool tanks with water spray. Cool containers exposed to flames with water until well after the fire is out. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Vapors may form explosive air mixtures even at room temperature. Prevent buildup of vapors or gases to explosive concentrations. Some of these materials, if spilled, may evaporate leaving a flammable residue. Water runoff can cause environmental damage. Use compatible foam to minimize vapor generation as needed.
Specific methods	Use water spray to cool unopened containers.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Local authorities should be advised if significant spills cannot be contained. Keep upwind. Keep out of low areas. Ventilate closed spaces before entering. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. See Section 8 of the SDS for Personal Protective Equipment.
Methods and materials for containment and cleaning up	ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Extinguish all flames in the vicinity. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Small Spills: Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Cover with plastic sheet to prevent spreading. Collect spillage. Following product recovery, flush area with water. Prevent product from entering drains. Do not allow material to contaminate ground water system. Clean surface thoroughly to remove residual contamination. Wipe up with absorbent material (e.g. cloth, fleece). Large Spills: Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. This material and its container must be disposed of as hazardous waste.
Environmental precautions	If facility or operation has an "oil or hazardous substance contingency plan", activate its procedures. Stay upwind and away from spill. Wear appropriate protective equipment including respiratory protection as conditions warrant. Do not enter or stay in area unless monitoring indicates that it is safe to do so. Isolate hazard area and restrict entry to emergency crew. Flammable. Review Firefighting Measures, Section 5, before proceeding with clean up. Keep all sources of ignition (flames, smoking, flares, etc.) and hot surfaces away from release. Contain spill in smallest possible area. Recover as much product as possible (e.g. by vacuuming). Stop leak if it can be done without risk. Use water spray to disperse vapors. Use compatible foam to minimize vapor generation as needed. Spilled material may be absorbed by an appropriate absorbent, and then handled in accordance with environmental regulations. Prevent spilled material from entering sewers, storm drains, other unauthorized treatment or drainage systems and natural waterways. Contact fire authorities and appropriate federal, state and local agencies. If spill of any amount is made into or upon navigable waters, the contiguous zone, or adjoining shorelines, contact the National Response Center at 1-800-424-8802. For highway or railways spills, contact Chemtrec at 1-800-424-9300.

7. Handling and storage

Precautions for safe handling	Eliminate sources of ignition. Avoid spark promoters. Ground/bond container and equipment. These alone may be insufficient to remove static electricity. Wear personal protective equipment. Do not breathe gas/fumes/vapor/spray. Avoid contact with eyes, skin, and clothing. Do not taste or swallow. Avoid prolonged exposure. Use only with adequate ventilation. Wash thoroughly after handling. The product is flammable, and heating may generate vapors which may form explosive vapor/air mixtures. DO NOT handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. When using, do not eat, drink or smoke. Avoid release to the environment.
Conditions for safe storage, including any incompatibilities	Flammable liquid storage. Do not handle or store near an open flame, heat or other sources of ignition. This material can accumulate static charge which may cause spark and become an ignition source. The pressure in sealed containers can increase under the influence of heat. Keep container tightly closed in a cool, well-ventilated place. Keep away from food, drink and animal feedingstuffs. Keep out of the reach of children.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Components	Type	Value
Benzene (CAS 71-43-2)	STEL	5 ppm
	TWA	1 ppm

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Cyclohexane (CAS 110-82-7)	PEL	1050 mg/m3
		300 ppm
Ethylbenzene (CAS 100-41-4)	PEL	435 mg/m3
		100 ppm
Naphthalene (CAS 91-20-3)	PEL	50 mg/m3
		10 ppm
n-Heptane (CAS 142-82-5)	PEL	2000 mg/m3
		500 ppm
n-Hexane (CAS 110-54-3)	PEL	1800 mg/m3
		500 ppm
Octane (all isomers) (CAS 111-65-9)	PEL	2350 mg/m3
		500 ppm
Xylene (o,m,p isomers) (CAS 1330-20-7)	PEL	435 mg/m3
		100 ppm

US. OSHA Table Z-2 (29 CFR 1910.1000)

Components	Type	Value
Benzene (CAS 71-43-2)	Ceiling	25 ppm
	TWA	10 ppm
Hydrogen sulfide (CAS 7783-06-4)	Ceiling	20 ppm
Toluene (CAS 108-88-3)	Ceiling	300 ppm
	TWA	200 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value
Benzene (CAS 71-43-2)	STEL	2.5 ppm
	TWA	0.5 ppm
Cyclohexane (CAS 110-82-7)	TWA	100 ppm
Ethylbenzene (CAS 100-41-4)	TWA	20 ppm
Hexane (Other Isomers) (CAS 96-14-0)	STEL	1000 ppm
	TWA	500 ppm
Hydrogen sulfide (CAS 7783-06-4)	STEL	5 ppm
	TWA	1 ppm
Naphthalene (CAS 91-20-3)	STEL	15 ppm
	TWA	10 ppm
n-Heptane (CAS 142-82-5)	STEL	500 ppm
	TWA	400 ppm
n-Hexane (CAS 110-54-3)	TWA	50 ppm
n-Nonane (CAS 111-84-2)	TWA	200 ppm
Octane (all isomers) (CAS 111-65-9)	TWA	300 ppm
Toluene (CAS 108-88-3)	TWA	20 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value
Xylene (o,m,p isomers) (CAS 1330-20-7)	STEL	150 ppm
	TWA	100 ppm

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Benzene (CAS 71-43-2)	STEL	1 ppm
	TWA	0.1 ppm
Cyclohexane (CAS 110-82-7)	TWA	1050 mg/m3
		300 ppm
Ethylbenzene (CAS 100-41-4)	STEL	545 mg/m3
		125 ppm
	TWA	435 mg/m3
		100 ppm
Hexane (Other Isomers) (CAS 96-14-0)	Ceiling	1800 mg/m3
		510 ppm
	TWA	350 mg/m3
		100 ppm
Hydrogen sulfide (CAS 7783-06-4)	Ceiling	15 mg/m3
		10 ppm
Naphthalene (CAS 91-20-3)	STEL	75 mg/m3
		15 ppm
	TWA	50 mg/m3
		10 ppm
n-Heptane (CAS 142-82-5)	Ceiling	1800 mg/m3
		440 ppm
	TWA	350 mg/m3
		85 ppm
n-Hexane (CAS 110-54-3)	TWA	180 mg/m3
		50 ppm
n-Nonane (CAS 111-84-2)	TWA	1050 mg/m3
		200 ppm
Octane (all isomers) (CAS 111-65-9)	Ceiling	1800 mg/m3
		385 ppm
	TWA	350 mg/m3
		75 ppm
Toluene (CAS 108-88-3)	STEL	560 mg/m3
		150 ppm
	TWA	375 mg/m3
		100 ppm
Xylene (o,m,p isomers) (CAS 1330-20-7)	STEL	655 mg/m3
		150 ppm
	TWA	435 mg/m3
		100 ppm

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Benzene (CAS 71-43-2)	25 µg/g	S-Phenylmercapturic acid	Creatinine in urine	*

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Ethylbenzene (CAS 100-41-4)	0.7 g/g	Sum of mandelic acid and phenylglyoxylic acid	Creatinine in urine	*
n-Hexane (CAS 110-54-3)	0.4 mg/l	2,5-Hexanedion, without hydrolysis	Urine	*
	0.4 mg/l	2,5-Hexanedi - on, without hydrolysis		*
Toluene (CAS 108-88-3)	0.3 mg/g	o-Cresol, with hydrolysis	Creatinine in urine	*
	0.03 mg/l	Toluene	Urine	*
	0.02 mg/l	Toluene	Blood	*
Xylene (o,m,p isomers) (CAS 1330-20-7)	1.5 g/g	Methylhippuric acids	Creatinine in urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

Benzene (CAS 71-43-2)	Can be absorbed through the skin.
n-Hexane (CAS 110-54-3)	Can be absorbed through the skin.
Toluene (CAS 108-88-3)	Can be absorbed through the skin.

US - Minnesota Haz Subs: Skin designation applies

Toluene (CAS 108-88-3)	Skin designation applies.

US ACGIH Threshold Limit Values: Skin designation

Benzene (CAS 71-43-2)	Can be absorbed through the skin.
Naphthalene (CAS 91-20-3)	Can be absorbed through the skin.
n-Hexane (CAS 110-54-3)	Can be absorbed through the skin.

Appropriate engineering controls Provide adequate general and local exhaust ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof equipment.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses. If splash potential exists, wear full face shield or chemical goggles.

Skin protection

Hand protection Avoid exposure - obtain special instructions before use. Wear protective gloves. Protective gloves.

Other Wear chemical-resistant, impervious gloves. Full body suit and boots are recommended when handling large volumes or in emergency situations. Flame retardant protective clothing is recommended.

Respiratory protection Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. 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. If workplace exposure limits for product or components are exceeded, NIOSH approved equipment should be worn. Proper respirator selection should be determined by adequately trained personnel, based on the contaminants, the degree of potential exposure and published respiratory protection factors. This equipment should be available for nonroutine and emergency use.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations Avoid contact with eyes. Avoid contact with skin. Keep away from food and drink. Wash hands before breaks and immediately after handling the product. Provide eyewash station and safety shower. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Liquid (may be dyed red).

Physical state Liquid.

Form Liquid.

Color Clear. Straw. Black. Brown. Green.

Odor	Kerosene (strong).
Odor threshold	Not available.
pH	Not available.
Melting point/freezing point	-60.1 °F (-51.17 °C) May start to solidify at this temperature. This is based on data for the following ingredient: n-Nonane. Weighted average: -147.2 degrees F (-99.54 degrees C)
Initial boiling point and boiling range	199.9 - 900.1 °F (93.28 - 482.28 °C)
Flash point	> 100.0 °F (> 37.8 °C) Closed Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	0.4
Flammability limit - upper (%)	8
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	< 1 mm Hg (20°C)
Vapor density	3 - 7 (Air=1)
Relative density	0.84 - 0.93 (Water=1) (60°F)
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	495 °F (257.22 °C)
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
Percent volatile	Negligible.

10. Stability and reactivity

Reactivity	Not available.
Chemical stability	Stable under normal temperature conditions and recommended use.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat, flames and sparks. Ignition sources. Contact with incompatible materials. Do not pressurize, cut, weld, braze, solder, drill, grind or expose empty containers to heat, flame, sparks, static electricity, or other sources of ignition; they may explode and cause injury or death.
Incompatible materials	Oxidizing agents.
Hazardous decomposition products	Trace amounts of: Hydrogen sulfide.

11. Toxicological information

Information on likely routes of exposure	
Ingestion	May be fatal if swallowed and enters airways.
Inhalation	May be harmful if inhaled. In high concentrations, vapors and spray mists are narcotic and may cause headache, fatigue, dizziness and nausea.
Skin contact	May cause skin irritation. Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
Eye contact	May cause eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Cyanosis (blue tissue condition, nails, lips, and/or skin). Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash.

Information on toxicological effects

Acute toxicity Based on available data, the classification criteria are not met.

Components	Species	Test Results
Benzene (CAS 71-43-2)		
Acute		
Oral		
LD50	Rat	930 mg/kg
Cyclohexane (CAS 110-82-7)		
Acute		
Oral		
LD50	Rat	12705 mg/kg
Ethylbenzene (CAS 100-41-4)		
Acute		
Dermal		
LD50	Rabbit	> 5000 mg/kg
Oral		
LD50	Rat	5.46 g/kg
Hydrogen sulfide (CAS 7783-06-4)		
Acute		
Inhalation		
LC50	Mouse	> 0.024 mg/l, 960 Minutes
	Rat	1.5 mg/l, 14 Minutes
		> 0.38 mg/l, 960 Minutes
Naphthalene (CAS 91-20-3)		
Acute		
Dermal		
LD50	Rabbit	> 2 g/kg
Oral		
LD50	Rat	490 mg/kg
n-Heptane (CAS 142-82-5)		
Acute		
Inhalation		
LC50	Rat	103 mg/l, 4 Hours
n-Hexane (CAS 110-54-3)		
Acute		
Oral		
LD50	Rat	28710 mg/kg
n-Nonane (CAS 111-84-2)		
Acute		
Inhalation		
LC50	Rat	3200 mg/l, 4 Hours
Octane (all isomers) (CAS 111-65-9)		
Acute		
Inhalation		
LC50	Rat	118 mg/l, 4 Hours
Toluene (CAS 108-88-3)		
Acute		
Inhalation		
LC50	Rat	8000 mg/l, 4 Hours
Oral		
LD50	Rat	2.6 g/kg

Components	Species	Test Results
Xylene (o,m,p isomers) (CAS 1330-20-7)		
Acute		
Oral		
LD50	Rat	4300 mg/kg

Skin corrosion/irritation Based on available data, the classification criteria are not met.

Serious eye damage/eye irritation Based on available data, the classification criteria are not met.

Respiratory or skin sensitization

Respiratory sensitization Based on available data, the classification criteria are not met.

Skin sensitization Based on available data, the classification criteria are not met.

Germ cell mutagenicity Some middle distillate fuels have caused chromosome damage in the in-vivo rat bone marrow cytogenetics assay and caused mutagenic effects in the L5178Y mouse lymphoma assay. In in-vitro experiments, neither benzene, toluene nor xylene changed the number of sister-chromatid exchanges (SCEs) or the number of chromosomal aberrations in human lymphocytes. However, toluene and xylene caused a significant cell growth inhibition which was not observed with benzene in the same concentrations. In in-vivo experiments, toluene changed the number of sister-chromatid exchanges (SCEs) in human lymphocytes. Toluene may cause heritable genetic damage.

Carcinogenicity May cause cancer.

IARC Monographs. Overall Evaluation of Carcinogenicity

Benzene (CAS 71-43-2)	1 Carcinogenic to humans.
Ethylbenzene (CAS 100-41-4)	2B Possibly carcinogenic to humans.
Naphthalene (CAS 91-20-3)	2B Possibly carcinogenic to humans.
Toluene (CAS 108-88-3)	3 Not classifiable as to carcinogenicity to humans.
Xylene (o,m,p isomers) (CAS 1330-20-7)	3 Not classifiable as to carcinogenicity to humans.

NTP Report on Carcinogens

Benzene (CAS 71-43-2)	Known To Be Human Carcinogen.
Naphthalene (CAS 91-20-3)	Reasonably Anticipated to be a Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Benzene (CAS 71-43-2)	Cancer

Reproductive toxicity Benzene, xylene and toluene have demonstrated animal effects of reproductive toxicity. Animal studies of benzene have shown testicular effects, alterations in reproductive cycles, chromosomal aberrations and embryo/fetotoxicity. Napthalene interferes with embryo development in experimental animals at dose levels that cause maternal toxicity. In humans, excessive exposure to this agent may cause hemolytic anemia in the mother and fetus. May damage fertility or the unborn child. Can cause adverse reproductive effects - such as birth defects, miscarriages, or infertility. Avoid exposure to women during early pregnancy. Avoid contact during pregnancy/while nursing.

Specific target organ toxicity - single exposure Based on available data, the classification criteria are not met.

Specific target organ toxicity - repeated exposure May cause damage to the following organs through prolonged or repeated exposure: Blood. Liver. Kidney.

Aspiration hazard May be fatal if swallowed and enters airways.

Chronic effects Prolonged and repeated exposure to benzene may cause serious injury to blood forming organs and is associated with anemia and to the later development of acute myelogenous leukemia (AML). Toluene has been reported to decrease immunological responses and cause recordable hearing loss in laboratory animals. Repeated exposure to naphthalene may cause cataracts, allergic skin rashes, destruction of red blood cells, and anemia, jaundice, kidney and liver damage. Contains organic solvents which in case of overexposure may depress the central nervous system causing dizziness and intoxication. Danger of serious damage to health by prolonged exposure. Prolonged or repeated overexposure may cause central nervous system, kidney, liver, and lung damage.

Further information Symptoms may be delayed.

12. Ecological information

Ecotoxicity Toxic to aquatic life with long lasting effects.

Components		Species	Test Results
Benzene (CAS 71-43-2)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	8.76 - 15.6 mg/l, 48 Hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	5.9 mg/l, 96 hours
Cyclohexane (CAS 110-82-7)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	3.961 - 5.181 mg/l, 96 hours
		Striped bass (Morone saxatilis)	8.3 mg/l, 96 hours
Ethylbenzene (CAS 100-41-4)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1 - 4 mg/l, 48 hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	4 mg/l, 96 hours
Hydrogen sulfide (CAS 7783-06-4)			
Aquatic			
Fish	LC50	Bluegill (Lepomis macrochirus)	0.009 mg/l, 96 hours
Naphthalene (CAS 91-20-3)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1.09 - 3.4 mg/l, 48 hours
Fish	LC50	Pink salmon (Oncorhynchus gorbuscha)	0.95 - 1.62 mg/l, 96 hours
n-Heptane (CAS 142-82-5)			
Aquatic			
Fish	LC50	Western mosquitofish (Gambusia affinis)	4924 mg/l, 96 hours
n-Hexane (CAS 110-54-3)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	2.101 - 2.981 mg/l, 96 hours
Toluene (CAS 108-88-3)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	5.46 - 9.83 mg/l, 48 hours
Fish	LC50	Pink salmon (Oncorhynchus gorbuscha)	7.45 - 8.78 mg/l, 96 hours
Xylene (o,m,p isomers) (CAS 1330-20-7)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	8 mg/l, 96 Hours

Persistence and degradability	None known.
Bioaccumulative potential	Not available.

Partition coefficient n-octanol / water (log Kow)

Benzene (CAS 71-43-2)	2.13
Cyclohexane (CAS 110-82-7)	3.44
Ethylbenzene (CAS 100-41-4)	3.15
Hexane (Other Isomers) (CAS 96-14-0)	3.6
Octane (all isomers) (CAS 111-65-9)	5.18
Toluene (CAS 108-88-3)	2.73
Xylene (o,m,p isomers) (CAS 1330-20-7)	3.2
n-Heptane (CAS 142-82-5)	4.66
n-Hexane (CAS 110-54-3)	3.9
n-Nonane (CAS 111-84-2)	5.46

Mobility in soil	Not available.
Other adverse effects	Not available.

13. Disposal considerations

Disposal instructions	Dispose in accordance with all applicable regulations. This material and its container must be disposed of as hazardous waste. Dispose of this material and its container to hazardous or special waste collection point. Incinerate the material under controlled conditions in an approved incinerator. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container.
Hazardous waste code	D001: Waste Flammable material with a flash point <140 °F D018: Waste Benzene

US RCRA Hazardous Waste U List: Reference

Benzene (CAS 71-43-2)	U019
Cyclohexane (CAS 110-82-7)	U056
Hydrogen sulfide (CAS 7783-06-4)	U135
Naphthalene (CAS 91-20-3)	U165
Toluene (CAS 108-88-3)	U220
Xylene (o,m,p isomers) (CAS 1330-20-7)	U239

Waste from residues / unused products	Dispose of in accordance with local regulations.
Contaminated packaging	Offer rinsed packaging material to local recycling facilities.

14. Transport information

DOT

UN number	UN1268
UN proper shipping name	Petroleum distillates, n.o.s.
Transport hazard class(es)	
Class	Combustible Liquid
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	Yes
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	144, B1, IB3, T4, TP1, TP29
Packaging exceptions	150
Packaging non bulk	203
Packaging bulk	242

IATA

UN number	UN1268
UN proper shipping name	Petroleum products, n.o.s.
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	III
Environmental hazards	Yes
ERG Code	3L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN1268
UN proper shipping name	Petroleum distillates, n.o.s.
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	Yes
EmS	F-E, S-E
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	Not applicable. However, this product is a liquid and if transported in bulk covered under MARPOL 73/78, Annex I.

15. Regulatory information

US federal regulations	This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200. All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

n-Nonane (CAS 111-84-2)	1.0 % One-Time Export Notification only.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Benzene (CAS 71-43-2)	Cancer Central nervous system Blood Aspiration Skin Eye Respiratory tract irritation Flammability

CERCLA Hazardous Substance List (40 CFR 302.4)

Benzene (CAS 71-43-2)	LISTED
Cyclohexane (CAS 110-82-7)	LISTED
Ethylbenzene (CAS 100-41-4)	LISTED
Hexane (Other Isomers) (CAS 96-14-0)	LISTED
Hydrogen sulfide (CAS 7783-06-4)	LISTED
Naphthalene (CAS 91-20-3)	LISTED
n-Heptane (CAS 142-82-5)	LISTED
n-Hexane (CAS 110-54-3)	LISTED
n-Nonane (CAS 111-84-2)	LISTED
Octane (all isomers) (CAS 111-65-9)	LISTED
Toluene (CAS 108-88-3)	LISTED
Xylene (o,m,p isomers) (CAS 1330-20-7)	LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - No Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Chemical name	CAS number	Reportable quantity	Threshold planning quantity	Threshold planning quantity, lower value	Threshold planning quantity, upper value
Hydrogen sulfide	7783-06-4	100	500 lbs		

SARA 311/312 Hazardous chemical	Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Cyclohexane	110-82-7	0 - 1
Ethylbenzene	100-41-4	0 - 1
Hydrogen sulfide	7783-06-4	0 - 1
Naphthalene	91-20-3	0 - 1
Toluene	108-88-3	0 - 1
Xylene (o,m,p isomers)	1330-20-7	0 - 1
n-Hexane	110-54-3	0 - 1
Benzene	71-43-2	0 - 0.5

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Benzene (CAS 71-43-2)
Ethylbenzene (CAS 100-41-4)
Naphthalene (CAS 91-20-3)
n-Hexane (CAS 110-54-3)
Toluene (CAS 108-88-3)
Xylene (o,m,p isomers) (CAS 1330-20-7)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Hydrogen sulfide (CAS 7783-06-4)

Safe Drinking Water Act (SDWA)	Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Toluene (CAS 108-88-3)	6594

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Toluene (CAS 108-88-3)	35 % weight/volumn

DEA Exempt Chemical Mixtures Code Number

Toluene (CAS 108-88-3)	594

US state regulations	WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Benzene (CAS 71-43-2)
Cyclohexane (CAS 110-82-7)
Ethylbenzene (CAS 100-41-4)
Hexane (Other Isomers) (CAS 96-14-0)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
n-Heptane (CAS 142-82-5)
n-Hexane (CAS 110-54-3)
n-Nonane (CAS 111-84-2)
Octane (all isomers) (CAS 111-65-9)
Toluene (CAS 108-88-3)
Xylene (o,m,p isomers) (CAS 1330-20-7)

US. New Jersey Worker and Community Right-to-Know Act

Benzene (CAS 71-43-2)
Cyclohexane (CAS 110-82-7)
Ethylbenzene (CAS 100-41-4)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
n-Heptane (CAS 142-82-5)
n-Hexane (CAS 110-54-3)
n-Nonane (CAS 111-84-2)
Octane (all isomers) (CAS 111-65-9)
Toluene (CAS 108-88-3)
Xylene (o,m,p isomers) (CAS 1330-20-7)

US. Pennsylvania Worker and Community Right-to-Know Law

Benzene (CAS 71-43-2)
Cyclohexane (CAS 110-82-7)
Ethylbenzene (CAS 100-41-4)
Hexane (Other Isomers) (CAS 96-14-0)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
n-Heptane (CAS 142-82-5)
n-Hexane (CAS 110-54-3)
n-Nonane (CAS 111-84-2)
Octane (all isomers) (CAS 111-65-9)
Toluene (CAS 108-88-3)
Xylene (o,m,p isomers) (CAS 1330-20-7)

US. Rhode Island RTK

Benzene (CAS 71-43-2)
Cyclohexane (CAS 110-82-7)
Ethylbenzene (CAS 100-41-4)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
n-Hexane (CAS 110-54-3)
Toluene (CAS 108-88-3)
Xylene (o,m,p isomers) (CAS 1330-20-7)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Benzene (CAS 71-43-2)
Ethylbenzene (CAS 100-41-4)
Naphthalene (CAS 91-20-3)
Toluene (CAS 108-88-3)

International Inventories

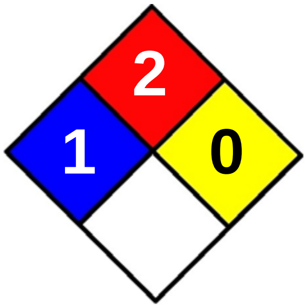
Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	No
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date	13-May-2013
Revision date	23-May-2014
Version #	03

NFPA Ratings



References

ACGIH
EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

This material Safety Data Sheet (SDS) was prepared in accordance with 29 CFR 1910.1200 by Valero Marketing & Supply Co., ("VALERO"). VALERO does not assume any liability arising out of product use by others. The information, recommendations, and suggestions presented in this SDS are based upon test results and data believed to be reliable. The end user of the product has the responsibility for evaluating the adequacy of the data under the conditions of use, determining the safety, toxicity and suitability of the product under these conditions, and obtaining additional or clarifying information where uncertainty exists. No guarantee expressed or implied is made as to the effects of such use , the results to be obtained, or the safety and toxicity of the product in any specific application. Furthermore, the information herein is not represented as absolutely complete, since it is not practicable to provide all the scientific and study information in the format of this document, plus additional information may be necessary under exceptional conditions of use, or because of applicable laws or government regulations.

SAFETY DATA SHEET

1. Identification

Product identifier	**No. 6 Fuel Oil**
Other means of identification	
SDS number	203-GHS
Synonyms	Residual Fuel Oil, Resid, Residue, Heavy Fuel Oil See section 16 for complete information.
Recommended use	Refinery feedstock.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer/Supplier	Valero Marketing & Supply Company and Affiliates One Valero Way San Antonio, TX 78269-6000
General Assistance	210-345-4593
E-Mail	CorpHSE@valero.com
Contact Person	Industrial Hygienist
Emergency Telephone	24 Hour Emergency 866-565-5220 1-800-424-9300 (CHEMTREC USA)

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 4
Health hazards	Acute toxicity, oral	Category 4
	Acute toxicity, inhalation	Category 4
	Carcinogenicity	Category 1B
	Reproductive toxicity	Category 2
	Specific target organ toxicity, repeated exposure	Category 2
	Aspiration hazard	Category 1
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	May be fatal if swallowed and enters airways. Harmful if inhaled. Suspected of causing cancer. Suspected of damaging fertility or the unborn child. May cause damage to organs (blood, liver, kidney) through prolonged or repeated exposure.
Precautionary statement	
Prevention	Keep away from flames and hot surfaces. - No smoking. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not breathe mist/vapors/spray. Wear protective gloves/protective clothing/eye protection/face protection. Use only outdoors or in a well-ventilated area.
Response	If exposed or concerned: Get medical advice/attention. If swallowed: Immediately call a poison center/doctor. Do NOT induce vomiting. If inhaled: Remove person to fresh air and keep comfortable for breathing. In case of fire: Use foam, carbon dioxide, dry powder or water fog for extinction.

Storage	Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Clarified oils (Petroleum), catalytic cracked	64741-62-4	0-100
Clarified oils (petroleum), hydrodesulfurized catalytic cracked	68333-26-6	0-100
Distillates (petroleum), heavy catalytic cracked	64741-61-3	0-100
Distillates, petroleum residues vacuum	68955-27-1	0-100
Fuel Oil No. 6	68553-00-4	0-100
Fuel oil, residual	68476-33-5	0-100
Residues (petroleum), light vacuum	68512-62-9	0-100
Polycyclic Aromatic Hydrocarbons	130498-29-2	0-10
Asphaltenes (petroleum)	91995-23-2	0-5
Naphthalene	91-20-3	0-3
Hydrogen sulfide	7783-06-4	0-1
Sulfur	7704-34-9	0-1

Composition comments	Small amount of hydrogen sulfide, a highly toxic gas, may be present, especially in the headspace of containers.

4. First-aid measures

Inhalation	Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention.
Skin contact	Remove contaminated clothing and shoes. Wash off immediately with soap and plenty of water. Get medical attention if irritation develops or persists. Wash clothing separately before reuse. Destroy or thoroughly clean contaminated shoes. If high pressure injection under the skin occurs, always seek medical attention.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention.
Ingestion	Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center. Do not give mouth-to-mouth resuscitation. If vomiting occurs, keep head low so that stomach content does not get into the lungs. Never give anything by mouth to a victim who is unconscious or is having convulsions. Get medical attention immediately.
Most important symptoms/effects, acute and delayed	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash. Hydrogen sulfide, a highly toxic gas, may be present. Signs and symptoms of overexposure to hydrogen sulfide include respiratory and eye irritation, dizziness, nausea, coughing, a sensation of dryness and pain in the nose, and loss of consciousness. Odor does not provide a reliable indicator of the presence of hazardous levels in the atmosphere.
Indication of immediate medical attention and special treatment needed	In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.

General information	If exposed or concerned: get medical attention/advice. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before re-use.

5. Fire-fighting measures

Suitable extinguishing media	Water spray. Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use a solid water stream as it may scatter and spread fire.
Specific hazards arising from the chemical	Combustible liquid and vapor. Vapor may cause flash fire. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
Special protective equipment and precautions for firefighters	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.
Fire-fighting equipment/instructions	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask. Withdraw immediately in case of rising sound from venting safety devices or any discoloration of tanks due to fire. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Move containers from fire area if you can do it without risk. In the event of fire, cool tanks with water spray. Cool containers exposed to flames with water until well after the fire is out. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Vapors may form explosive air mixtures even at room temperature. Prevent buildup of vapors or gases to explosive concentrations. Some of these materials, if spilled, may evaporate leaving a flammable residue. Water runoff can cause environmental damage. Use compatible foam to minimize vapor generation as needed.
Specific methods	Use water spray to cool unopened containers.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Local authorities should be advised if significant spills cannot be contained. Keep upwind. Keep out of low areas. Ventilate closed spaces before entering. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. See Section 8 of the SDS for Personal Protective Equipment.
Methods and materials for containment and cleaning up	Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Local authorities should be advised if significant spillages cannot be contained. Stop leak if you can do so without risk. This material is a water pollutant and should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water. Dike the spilled material, where this is possible. Prevent entry into waterways, sewers, basements or confined areas. Use non-sparking tools and explosion-proof equipment. Small Spills: Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Clean surface thoroughly to remove residual contamination. This material and its container must be disposed of as hazardous waste. Large Spills: Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Prevent product from entering drains. Do not allow material to contaminate ground water system. Should not be released into the environment. Clean up in accordance with all applicable regulations.
Environmental precautions	If facility or operation has an "oil or hazardous substance contingency plan", activate its procedures. Stay upwind and away from spill. Wear appropriate protective equipment including respiratory protection as conditions warrant. Do not enter or stay in area unless monitoring indicates that it is safe to do so. Isolate hazard area and restrict entry to emergency crew. Flammable. Review Firefighting Measures, Section 5, before proceeding with clean up. Keep all sources of ignition (flames, smoking, flares, etc.) and hot surfaces away from release. Contain spill in smallest possible area. Recover as much product as possible (e.g. by vacuuming). Stop leak if it can be done without risk. Use water spray to disperse vapors. Use compatible foam to minimize vapor generation as needed. Spilled material may be absorbed by an appropriate absorbent, and then handled in accordance with environmental regulations. Prevent spilled material from entering sewers, storm drains, other unauthorized treatment or drainage systems and natural waterways. Contact fire authorities and appropriate federal, state and local agencies. If spill of any amount is made into or upon navigable waters, the contiguous zone, or adjoining shorelines, contact the National Response Center at 1-800-424-8802. For highway or railways spills, contact Chemtrec at 1-800-424-9300.

7. Handling and storage

Precautions for safe handling	Eliminate sources of ignition. Avoid spark promoters. Ground/bond container and equipment. These alone may be insufficient to remove static electricity. Wear personal protective equipment. Do not breathe dust/fume/gas/mist/vapors/spray. Avoid contact with eyes, skin, and clothing. Do not taste or swallow. Avoid prolonged exposure. Use only with adequate ventilation. Wash thoroughly after handling. DO NOT handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. When using, do not eat, drink or smoke. Avoid release to the environment.
Conditions for safe storage, including any incompatibilities	Follow rules for combustible liquids. Do not handle or store near an open flame, heat or other sources of ignition. This material can accumulate static charge which may cause spark and become an ignition source. The pressure in sealed containers can increase under the influence of heat. Keep container tightly closed in a cool, well-ventilated place. Keep away from food, drink and animal feedingstuffs. Keep out of the reach of children.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	PEL	5 mg/m3	Mist.
Fuel Oil No. 6 (CAS 68553-00-4)	PEL	5 mg/m3	Mist.
Fuel oil, residual (CAS 68476-33-5)	PEL	5 mg/m3	Mist.
Naphthalene (CAS 91-20-3)	PEL	50 mg/m3 10 ppm	

US. OSHA Table Z-2 (29 CFR 1910.1000)

Components	Type	Value
Hydrogen sulfide (CAS 7783-06-4)	Ceiling	20 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	TWA	5 mg/m3	Inhalable fraction.
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)	TWA	5 mg/m3	Inhalable fraction.
Fuel Oil No. 6 (CAS 68553-00-4)	TWA	5 mg/m3	Inhalable fraction.
Fuel oil, residual (CAS 68476-33-5)	TWA	5 mg/m3	Inhalable fraction.
Hydrogen sulfide (CAS 7783-06-4)	STEL	5 ppm	
	TWA	1 ppm	
Naphthalene (CAS 91-20-3)	STEL	15 ppm	
	TWA	10 ppm	

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.
Fuel Oil No. 6 (CAS 68553-00-4)	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
Fuel oil, residual (CAS 68476-33-5)	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.
Hydrogen sulfide (CAS 7783-06-4)	Ceiling	15 mg/m3	
		10 ppm	
Naphthalene (CAS 91-20-3)	STEL	75 mg/m3	
		15 ppm	
	TWA	50 mg/m3	
		10 ppm	

Biological limit values	No biological exposure limits noted for the ingredient(s).

Exposure guidelines

US ACGIH Threshold Limit Values: Skin designation

Naphthalene (CAS 91-20-3)	Can be absorbed through the skin.

Appropriate engineering controls	Provide adequate general and local exhaust ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof equipment.

Individual protection measures, such as personal protective equipment

Eye/face protection	Wear safety glasses. If splash potential exists, wear full face shield or chemical goggles.
Skin protection	
Hand protection	Wear chemical-resistant, impervious gloves. Suitable gloves can be recommended by the glove supplier. Be aware that the liquid may penetrate the gloves. Frequent change is advisable.
Other	Full body suit and boots are recommended when handling large volumes or in emergency situations. Flame retardant protective clothing is recommended.
Respiratory protection	Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. 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. If workplace exposure limits for product or components are exceeded, NIOSH approved equipment should be worn. Proper respirator selection should be determined by adequately trained personnel, based on the contaminants, the degree of potential exposure and published respiratory protection factors. This equipment should be available for nonroutine and emergency use.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Consult supervisor for special handling instructions. Avoid contact with eyes. Avoid contact with skin. Keep away from food and drink. Wash hands before breaks and immediately after handling the product. Provide eyewash station and safety shower. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance	Thick, black, oily liquid.
Physical state	Liquid.
Form	Oily liquid.
Color	Black.
Odor	Petroleum.
Odor threshold	Not available.
pH	Not applicable.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	350.04 - 1200 °F (176.69 - 648.89 °C)
Flash point	> 141.8 °F (> 61.0 °C) Pensky-Martens Closed Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.

Upper/lower flammability or explosive limits

Flammability limit - lower (%)	0.9

Flammability limit - upper (%)	7
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	< 0.7 kPa (20°C)
Vapor density	> 5 (Air = 1)
Relative density	0.88 - 1.02 (Water = 1)
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	> 600.06 °F (> 315.59 °C)
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	Not available.
Chemical stability	Stable under normal temperature conditions and recommended use.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat, flames and sparks. Ignition sources. Contact with incompatible materials. Do not pressurize, cut, weld, braze, solder, drill, grind or expose empty containers to heat, flame, sparks, static electricity, or other sources of ignition; they may explode and cause injury or death.
Incompatible materials	Strong oxidizing agents. Acids. Alkalis.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Ingestion	May be fatal if swallowed and enters airways.
Inhalation	Harmful if inhaled.
Skin contact	Prolonged or repeated skin contact may cause drying, cracking, or irritation.
Eye contact	May cause eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash.

Information on toxicological effects

Acute toxicity Harmful if inhaled. Harmful: may cause lung damage if swallowed.

Components	Species	Test Results
Hydrogen sulfide (CAS 7783-06-4)		
Acute		
Inhalation		
LC50	Mouse	> 0.024 mg/l, 960 Minutes
	Rat	1.5 mg/l, 14 Minutes
		> 0.38 mg/l, 960 Minutes
Naphthalene (CAS 91-20-3)		
Acute		
Dermal		
LD50	Rabbit	> 2 g/kg
Oral		
LD50	Rat	490 mg/kg

Skin corrosion/irritation Prolonged or repeated skin contact may cause drying, cracking, or irritation.

Serious eye damage/eye irritation	Based on available data, the classification criteria are not met.
Respiratory or skin sensitization	
Respiratory sensitization	Based on available data, the classification criteria are not met.
Skin sensitization	Based on available data, the classification criteria are not met.
Germ cell mutagenicity	In in-vitro experiments benzene did not change the number of sister-chromatid exchanges (SCEs) or the number of chromosomal aberrations in human lymphocytes.
Carcinogenicity	Suspected of causing cancer. Diesel exhaust has been reported to be an occupational hazard due to NIOSH-reported potential carcinogenic properties.

IARC Monographs. Overall Evaluation of Carcinogenicity

Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	2B Possibly carcinogenic to humans.
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)	2B Possibly carcinogenic to humans.
Fuel Oil No. 6 (CAS 68553-00-4)	2B Possibly carcinogenic to humans.
Fuel oil, residual (CAS 68476-33-5)	2B Possibly carcinogenic to humans.
Naphthalene (CAS 91-20-3)	2B Possibly carcinogenic to humans.

NTP Report on Carcinogens

Naphthalene (CAS 91-20-3)	Reasonably Anticipated to be a Human Carcinogen.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

Reproductive toxicity	Suspected of damaging fertility or the unborn child. Can cause adverse reproductive effects - such as birth defects, miscarriages, or infertility. Avoid contact during pregnancy/while nursing. Napthalene interferes with embryo development in experimental animals at dose levels that cause maternal toxicity. In humans, excessive exposure to this agent may cause hemolytic anemia in the mother and fetus.
Specific target organ toxicity - single exposure	Based on available data, the classification criteria are not met.
Specific target organ toxicity - repeated exposure	May cause damage to the following organs through prolonged or repeated exposure: Blood. Liver. Kidneys.
Aspiration hazard	May be fatal if swallowed and enters airways.
Chronic effects	Contains organic solvents which in case of overexposure may depress the central nervous system causing dizziness and intoxication. Repeated exposure to naphthalene may cause cataracts, allergic skin rashes, destruction of red blood cells, and anemia, jaundice, kidney and liver damage. Danger of serious damage to health by prolonged exposure. Prolonged or repeated overexposure may cause central nervous system, kidney, liver, and lung damage.
Further information	Symptoms may be delayed. Hydrogen sulfide, a highly toxic gas, may be present. Signs and symptoms of overexposure to hydrogen sulfide include respiratory and eye irritation, dizziness, nausea, coughing, a sensation of dryness and pain in the nose, and loss of consciousness. Odor does not provide a reliable indicator of the presence of hazardous levels in the atmosphere.

12. Ecological information

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Components		**Species**	**Test Results**
Hydrogen sulfide (CAS 7783-06-4)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.007 mg/l, 96 hours
Naphthalene (CAS 91-20-3)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1.09 - 3.4 mg/l, 48 hours
Fish	LC50	Pink salmon (Oncorhynchus gorbuscha)	0.95 - 1.62 mg/l, 96 hours
Residues (petroleum), light vacuum (CAS 68512-62-9)			
Aquatic			
Fish	LC50	Fish	48 mg/l, 48 Hours

Persistence and degradability Not available.

Bioaccumulative potential	Not available.
Mobility in soil	Not available.
Other adverse effects	Not available.

13. Disposal considerations

Disposal instructions	Dispose in accordance with all applicable regulations. This material and its container must be disposed of as hazardous waste. Dispose of this material and its container to hazardous or special waste collection point. Incinerate the material under controlled conditions in an approved incinerator. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container.
Hazardous waste code	Not regulated.

US RCRA Hazardous Waste U List: Reference

Hydrogen sulfide (CAS 7783-06-4)	U135
Naphthalene (CAS 91-20-3)	U165

Waste from residues / unused products	Dispose of in accordance with local regulations.
Contaminated packaging	Offer rinsed packaging material to local recycling facilities.

14. Transport information

DOT

UN number	UN3256
UN proper shipping name	Elevated temperature liquid, flammable, n.o.s. (No. 6 Fuel Oil)
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Label(s)	3
Packing group	III
Environmental hazards	
Marine pollutant	Yes
Special precautions for user	Not available.
Special provisions	IB1, T3, TP3, TP29
Packaging exceptions	None
Packaging non bulk	None
Packaging bulk	247

IATA

UN number	UN3256
UN proper shipping name	Elevated temperature liquid, flammable, n.o.s. (No. 6 Fuel Oil)
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	Not applicable.
Environmental hazards	Yes
ERG Code	3L
Special precautions for user	Not available.

IMDG

UN number	UN3256
UN proper shipping name	ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S. (No. 6 Fuel Oil)
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	Yes
EmS	F-E, S-D
Special precautions for user	Not available.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Hydrogen sulfide (CAS 7783-06-4)	LISTED
Naphthalene (CAS 91-20-3)	LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Chemical name	CAS number	Reportable quantity	Threshold planning quantity	Threshold planning quantity, lower value	Threshold planning quantity, upper value
Hydrogen sulfide	7783-06-4	100	500 lbs		

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Polycyclic Aromatic Hydrocarbons	130498-29-2	0-10
Naphthalene	91-20-3	0-3

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Naphthalene (CAS 91-20-3)
Polycyclic Aromatic Hydrocarbons (CAS 130498-29-2)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Hydrogen sulfide (CAS 7783-06-4)

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Fuel Oil No. 6 (CAS 68553-00-4)
Fuel oil, residual (CAS 68476-33-5)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
Sulfur (CAS 7704-34-9)

US. New Jersey Worker and Community Right-to-Know Act

Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)
Fuel oil, residual (CAS 68476-33-5)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
Polycyclic Aromatic Hydrocarbons (CAS 130498-29-2)
Sulfur (CAS 7704-34-9)

US. Pennsylvania Worker and Community Right-to-Know Law

Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)
Fuel oil, residual (CAS 68476-33-5)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)

Polycyclic Aromatic Hydrocarbons (CAS 130498-29-2)
Sulfur (CAS 7704-34-9)

US. Rhode Island RTK

Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

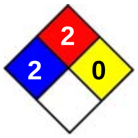
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)
Fuel Oil No. 6 (CAS 68553-00-4)
Fuel oil, residual (CAS 68476-33-5)
Naphthalene (CAS 91-20-3)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date	27-June-2013
Revision date	23-May-2014
Version #	02
NFPA ratings	
References	ACGIH EPA: AQUIRE database NLM: Hazardous Substances Data Base US. IARC Monographs on Occupational Exposures to Chemical Agents HSDB® - Hazardous Substances Data Bank IARC Monographs. Overall Evaluation of Carcinogenicity National Toxicology Program (NTP) Report on Carcinogens ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices
Disclaimer	This material Safety Data Sheet (SDS) was prepared in accordance with 29 CFR 1910.1200 by Valero Marketing & Supply Co., ("VALERO"). VALERO does not assume any liability arising out of product use by others. The information, recommendations, and suggestions presented in this SDS are based upon test results and data believed to be reliable. The end user of the product has the responsibility for evaluating the adequacy of the data under the conditions of use, determining the safety, toxicity and suitability of the product under these conditions, and obtaining additional or clarifying information where uncertainty exists. No guarantee expressed or implied is made as to the effects of such use , the results to be obtained, or the safety and toxicity of the product in any specific application. Furthermore, the information herein is not represented as absolutely complete, since it is not practicable to provide all the scientific and study information in the format of this document, plus additional information may be necessary under exceptional conditions of use, or because of applicable laws or government regulations.

SAFETY DATA SHEET

1. Identification

Product identifier	**Residual Fuel Oil**
Other means of identification	
SDS number	209-GHS
Synonyms	Residual Fuel Oil, No. 6 Fuel Oil, No. 5 Fuel Oil, No. 4 Fuel Oil, Bunker Fuel, Bunker "C" Oil, Resid, Residue, Heavy Fuel Oil See section 16 for complete information.
Recommended use	Refinery feedstock.
Recommended restrictions	None known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer/Supplier	Valero Marketing & Supply Company and Affiliates One Valero Way San Antonio, TX 78269-6000
General Assistance	210-345-4593
E-Mail	CorpHSE@valero.com
Contact Person	Industrial Hygienist
Emergency Telephone	24 Hour Emergency 866-565-5220 1-800-424-9300 (CHEMTREC USA)

2. Hazard(s) identification

Physical hazards	Not classified.	
Health hazards	Acute toxicity, oral	Category 4
	Acute toxicity, inhalation	Category 4
	Germ cell mutagenicity	Category 1B
	Carcinogenicity	Category 1B
	Reproductive toxicity	Category 2
	Specific target organ toxicity, repeated exposure	Category 2
	Aspiration hazard	Category 1
Environmental hazards	Hazardous to the aquatic environment, acute hazard	Category 1
	Hazardous to the aquatic environment, long-term hazard	Category 1
OSHA defined hazards	Not classified.	

Label elements

Signal word	Danger
Hazard statement	May be fatal if swallowed and enters airways. Harmful if inhaled. May cause genetic defects. Suspected of causing cancer. Suspected of damaging fertility or the unborn child. May cause damage to organs (blood, liver, kidney) through prolonged or repeated exposure.
Precautionary statement	
Prevention	Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not breathe mist/vapors/spray. Wear protective gloves/protective clothing/eye protection/face protection. Use only outdoors or in a well-ventilated area.
Response	If exposed or concerned: Get medical advice/attention. If swallowed: Immediately call a poison center/doctor. Do NOT induce vomiting. If inhaled: Remove person to fresh air and keep comfortable for breathing.

Storage	Store locked up.
Disposal	Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazard(s) not otherwise classified (HNOC)	None known.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Clarified oils (Petroleum), catalytic cracked	64741-62-4	0-100
Clarified oils (petroleum), hydrodesulfurized catalytic cracked	68333-26-6	0-100
Distillates (petroleum), heavy catalytic cracked	64741-61-3	0-100
Distillates, petroleum residues vacuum	68955-27-1	0-100
Fuel Oil No. 6	68553-00-4	0-100
Fuel oil, residual	68476-33-5	0-100
Residues (petroleum), light vacuum	68512-62-9	0-100
Polycyclic Aromatic Hydrocarbons	130498-29-2	0-10
Asphaltenes (petroleum)	91995-23-2	0-5
Naphthalene	91-20-3	0-3
Benzene	71-43-2	<1
Hydrogen sulfide	7783-06-4	0-1
Sulfur	7704-34-9	0-1

Composition comments	Small amount of hydrogen sulfide, a highly toxic gas, may be present, especially in the headspace of containers.

4. First-aid measures

Inhalation	Move to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention.
Skin contact	Remove contaminated clothing and shoes. Wash off immediately with soap and plenty of water. Get medical attention if irritation develops or persists. Wash clothing separately before reuse. Destroy or thoroughly clean contaminated shoes. If high pressure injection under the skin occurs, always seek medical attention.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention.
Ingestion	Rinse mouth thoroughly. Do not induce vomiting without advice from poison control center. Do not give mouth-to-mouth resuscitation. If vomiting occurs, keep head low so that stomach content does not get into the lungs. Never give anything by mouth to a victim who is unconscious or is having convulsions. Get medical attention immediately.
Most important symptoms/effects, acute and delayed	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash. Hydrogen sulfide, a highly toxic gas, may be present. Signs and symptoms of overexposure to hydrogen sulfide include respiratory and eye irritation, dizziness, nausea, coughing, a sensation of dryness and pain in the nose, and loss of consciousness. Odor does not provide a reliable indicator of the presence of hazardous levels in the atmosphere.
Indication of immediate medical attention and special treatment needed	In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.

General information	If exposed or concerned: get medical attention/advice. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Show this safety data sheet to the doctor in attendance. Wash contaminated clothing before re-use.

5. Fire-fighting measures

Suitable extinguishing media	Water spray. Water fog. Foam. Dry chemical powder. Carbon dioxide (CO2).
Unsuitable extinguishing media	Do not use a solid water stream as it may scatter and spread fire.
Specific hazards arising from the chemical	Vapor may cause flash fire. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
Special protective equipment and precautions for firefighters	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.
Fire-fighting equipment/instructions	Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask. Withdraw immediately in case of rising sound from venting safety devices or any discoloration of tanks due to fire. Fight fire from maximum distance or use unmanned hose holders or monitor nozzles. Move containers from fire area if you can do it without risk. In the event of fire, cool tanks with water spray. Cool containers exposed to flames with water until well after the fire is out. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Vapors may form explosive air mixtures even at room temperature. Prevent buildup of vapors or gases to explosive concentrations. Some of these materials, if spilled, may evaporate leaving a flammable residue. Water runoff can cause environmental damage. Use compatible foam to minimize vapor generation as needed.
Specific methods	Use water spray to cool unopened containers.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Local authorities should be advised if significant spills cannot be contained. Keep upwind. Keep out of low areas. Ventilate closed spaces before entering. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. See Section 8 of the SDS for Personal Protective Equipment.
Methods and materials for containment and cleaning up	Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Local authorities should be advised if significant spillages cannot be contained. Stop leak if you can do so without risk. This material is a water pollutant and should be prevented from contaminating soil or from entering sewage and drainage systems and bodies of water. Dike the spilled material, where this is possible. Prevent entry into waterways, sewers, basements or confined areas. Use non-sparking tools and explosion-proof equipment. Small Spills: Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Clean surface thoroughly to remove residual contamination. This material and its container must be disposed of as hazardous waste. Large Spills: Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Prevent product from entering drains. Do not allow material to contaminate ground water system. Should not be released into the environment. Clean up in accordance with all applicable regulations.
Environmental precautions	If facility or operation has an "oil or hazardous substance contingency plan", activate its procedures. Stay upwind and away from spill. Wear appropriate protective equipment including respiratory protection as conditions warrant. Do not enter or stay in area unless monitoring indicates that it is safe to do so. Isolate hazard area and restrict entry to emergency crew. Flammable. Review Firefighting Measures, Section 5, before proceeding with clean up. Keep all sources of ignition (flames, smoking, flares, etc.) and hot surfaces away from release. Contain spill in smallest possible area. Recover as much product as possible (e.g. by vacuuming). Stop leak if it can be done without risk. Use water spray to disperse vapors. Use compatible foam to minimize vapor generation as needed. Spilled material may be absorbed by an appropriate absorbent, and then handled in accordance with environmental regulations. Prevent spilled material from entering sewers, storm drains, other unauthorized treatment or drainage systems and natural waterways. Contact fire authorities and appropriate federal, state and local agencies. If spill of any amount is made into or upon navigable waters, the contiguous zone, or adjoining shorelines, contact the National Response Center at 1-800-424-8802. For highway or railways spills, contact Chemtrec at 1-800-424-9300.

7. Handling and storage

Precautions for safe handling	Eliminate sources of ignition. Avoid spark promoters. Ground/bond container and equipment. These alone may be insufficient to remove static electricity. Wear personal protective equipment. Do not breathe dust/fume/gas/mist/vapors/spray. Avoid contact with eyes, skin, and clothing. Do not taste or swallow. Avoid prolonged exposure. Use only with adequate ventilation. Wash thoroughly after handling. DO NOT handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. When using, do not eat, drink or smoke. Avoid release to the environment.
Conditions for safe storage, including any incompatibilities	Follow rules for combustible liquids. Do not handle or store near an open flame, heat or other sources of ignition. This material can accumulate static charge which may cause spark and become an ignition source. The pressure in sealed containers can increase under the influence of heat. Keep container tightly closed in a cool, well-ventilated place. Keep away from food, drink and animal feedingstuffs. Keep out of the reach of children.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Components	Type	Value
Benzene (CAS 71-43-2)	STEL	5 ppm
	TWA	1 ppm

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	PEL	5 mg/m3	Mist.
Fuel Oil No. 6 (CAS 68553-00-4)	PEL	5 mg/m3	Mist.
Fuel oil, residual (CAS 68476-33-5)	PEL	5 mg/m3	Mist.
Naphthalene (CAS 91-20-3)	PEL	50 mg/m3	
		10 ppm	

US. OSHA Table Z-2 (29 CFR 1910.1000)

Components	Type	Value
Benzene (CAS 71-43-2)	Ceiling	25 ppm
	TWA	10 ppm
Hydrogen sulfide (CAS 7783-06-4)	Ceiling	20 ppm

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Benzene (CAS 71-43-2)	STEL	2.5 ppm	
	TWA	0.5 ppm	
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	TWA	5 mg/m3	Inhalable fraction.
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)	TWA	5 mg/m3	Inhalable fraction.
Fuel Oil No. 6 (CAS 68553-00-4)	TWA	5 mg/m3	Inhalable fraction.
Fuel oil, residual (CAS 68476-33-5)	TWA	5 mg/m3	Inhalable fraction.
Hydrogen sulfide (CAS 7783-06-4)	STEL	5 ppm	
	TWA	1 ppm	
Naphthalene (CAS 91-20-3)	STEL	15 ppm	
	TWA	10 ppm	

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value	Form
Benzene (CAS 71-43-2)	STEL	1 ppm	
	TWA	0.1 ppm	
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.
Fuel Oil No. 6 (CAS 68553-00-4)	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.
Fuel oil, residual (CAS 68476-33-5)	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.
Hydrogen sulfide (CAS 7783-06-4)	Ceiling	15 mg/m3	
		10 ppm	
Naphthalene (CAS 91-20-3)	STEL	75 mg/m3	
		15 ppm	
	TWA	50 mg/m3	
		10 ppm	

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Benzene (CAS 71-43-2)	25 µg/g	S-Phenylmercapturic acid	Creatinine in urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

Benzene (CAS 71-43-2)	Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

Benzene (CAS 71-43-2)	Can be absorbed through the skin.
Naphthalene (CAS 91-20-3)	Can be absorbed through the skin.

Appropriate engineering controls Provide adequate general and local exhaust ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. Use explosion-proof equipment.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses. If splash potential exists, wear full face shield or chemical goggles.

Skin protection

Hand protection Wear chemical-resistant, impervious gloves. Suitable gloves can be recommended by the glove supplier. Be aware that the liquid may penetrate the gloves. Frequent change is advisable.

Other Full body suit and boots are recommended when handling large volumes or in emergency situations. Flame retardant protective clothing is recommended.

Respiratory protection Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. 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. If workplace exposure limits for product or components are exceeded, NIOSH approved equipment should be worn. Proper respirator selection should be determined by adequately trained personnel, based on the contaminants, the degree of potential exposure and published respiratory protection factors. This equipment should be available for nonroutine and emergency use.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations Consult supervisor for special handling instructions. Avoid contact with eyes. Avoid contact with skin. Keep away from food and drink. Wash hands before breaks and immediately after handling the product. Provide eyewash station and safety shower. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Thick, black, oily liquid.

Physical state	Liquid.
Form	Oily liquid.
Color	Black.
Odor	Petroleum.
Odor threshold	Not available.
pH	Not applicable.
Melting point/freezing point	Not available.
Initial boiling point and boiling range	350.04 - 1200 °F (176.69 - 648.89 °C)
Flash point	> 141.8 °F (> 61.0 °C) Pensky-Martens Closed Cup
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	0.9
Flammability limit - upper (%)	7
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	< 0.7 kPa (20°C)
Vapor density	> 5 (Air = 1)
Relative density	0.88 - 1.02 (water=1)
Solubility(ies)	
Solubility (water)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	> 315.59 °F (> 157.55 °C)
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	Not available.
Chemical stability	Stable under normal temperature conditions and recommended use.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat, flames and sparks. Ignition sources. Contact with incompatible materials. Do not pressurize, cut, weld, braze, solder, drill, grind or expose empty containers to heat, flame, sparks, static electricity, or other sources of ignition; they may explode and cause injury or death.
Incompatible materials	Strong oxidizing agents. Acids. Alkalis.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure	
Ingestion	May be fatal if swallowed and enters airways.
Inhalation	Harmful if inhaled.
Skin contact	Prolonged or repeated skin contact may cause drying, cracking, or irritation.
Eye contact	May cause eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation. Unconsciousness. Corneal damage. Narcosis. Decrease in motor functions. Behavioral changes. Edema. Liver enlargement. Jaundice. Conjunctivitis. Proteinuria. Defatting of the skin. Rash.
Information on toxicological effects	
Acute toxicity	Harmful if inhaled. Harmful: may cause lung damage if swallowed.

Components	Species	Test Results
Benzene (CAS 71-43-2)		
Acute		
Inhalation		
LC50	Mouse	9980 ppm
		9980 ppm, 7 Hours
	Rat	43767 mg/m3, 4 Hours
		13700 ppm, 4 Hours
		10000 ppm, 7 Hours
Oral		
LD50	Rat	930 mg/kg
Hydrogen sulfide (CAS 7783-06-4)		
Acute		
Inhalation		
LC50	Mouse	> 0.024 mg/l, 960 Minutes
	Rat	1.5 mg/l, 14 Minutes
		> 0.38 mg/l, 960 Minutes
Naphthalene (CAS 91-20-3)		
Acute		
Dermal		
LD50	Rabbit	> 2 g/kg
Oral		
LD50	Rat	490 mg/kg

Skin corrosion/irritation Prolonged or repeated skin contact may cause drying, cracking, or irritation.

Serious eye damage/eye irritation Based on available data, the classification criteria are not met.

Respiratory or skin sensitization

Respiratory sensitization Based on available data, the classification criteria are not met.

Skin sensitization Based on available data, the classification criteria are not met.

Germ cell mutagenicity In in-vitro experiments benzene did not change the number of sister-chromatid exchanges (SCEs) or the number of chromosomal aberrations in human lymphocytes.

Carcinogenicity Suspected of causing cancer.
Diesel exhaust has been reported to be an occupational hazard due to NIOSH-reported potential carcinogenic properties.

IARC Monographs. Overall Evaluation of Carcinogenicity

Benzene (CAS 71-43-2)	1 Carcinogenic to humans.
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)	2B Possibly carcinogenic to humans.
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)	2B Possibly carcinogenic to humans.
Fuel Oil No. 6 (CAS 68553-00-4)	2B Possibly carcinogenic to humans.
Fuel oil, residual (CAS 68476-33-5)	2B Possibly carcinogenic to humans.
Naphthalene (CAS 91-20-3)	2B Possibly carcinogenic to humans.

NTP Report on Carcinogens

Benzene (CAS 71-43-2)	Known To Be Human Carcinogen.
Naphthalene (CAS 91-20-3)	Reasonably Anticipated to be a Human Carcinogen.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Benzene (CAS 71-43-2)	Cancer

Reproductive toxicity Suspected of damaging fertility or the unborn child. Can cause adverse reproductive effects - such as birth defects, miscarriages, or infertility. Avoid contact during pregnancy/while nursing.
Napthalene interferes with embryo development in experimental animals at dose levels that cause maternal toxicity. In humans, excessive exposure to this agent may cause hemolytic anemia in the mother and fetus.
Animal studies of benzene have shown testicular effects, alterations in reproductive cycles, chromosomal aberrations and embryo/fetotoxicity.

Specific target organ toxicity - single exposure	Based on available data, the classification criteria are not met.
Specific target organ toxicity - repeated exposure	May cause damage to the following organs through prolonged or repeated exposure: Blood. Liver. Kidneys.
Aspiration hazard	May be fatal if swallowed and enters airways.
Chronic effects	Contains organic solvents which in case of overexposure may depress the central nervous system causing dizziness and intoxication. Repeated exposure to naphthalene may cause cataracts, allergic skin rashes, destruction of red blood cells, and anemia, jaundice, kidney and liver damage. Danger of serious damage to health by prolonged exposure. Prolonged or repeated overexposure may cause central nervous system, kidney, liver, and lung damage.
Further information	Symptoms may be delayed. Hydrogen sulfide, a highly toxic gas, may be present. Signs and symptoms of overexposure to hydrogen sulfide include respiratory and eye irritation, dizziness, nausea, coughing, a sensation of dryness and pain in the nose, and loss of consciousness. Odor does not provide a reliable indicator of the presence of hazardous levels in the atmosphere.

12. Ecological information

Ecotoxicity Very toxic to aquatic life with long lasting effects.

Components		Species	Test Results
Benzene (CAS 71-43-2)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	8.76 - 15.6 mg/l, 48 Hours
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	5.3 mg/l, 96 hours
Hydrogen sulfide (CAS 7783-06-4)			
Aquatic			
Fish	LC50	Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.007 mg/l, 96 hours
Naphthalene (CAS 91-20-3)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1.09 - 3.4 mg/l, 48 hours
Fish	LC50	Pink salmon (Oncorhynchus gorbuscha)	0.95 - 1.62 mg/l, 96 hours
Residues (petroleum), light vacuum (CAS 68512-62-9)			
Aquatic			
Fish	LC50	Fish	48 mg/l, 48 Hours

Persistence and degradability	Not available.
Bioaccumulative potential	Not available.

Partition coefficient n-octanol / water (log Kow)

Benzene (CAS 71-43-2)	2.13

Mobility in soil	Not available.
Other adverse effects	Not available.

13. Disposal considerations

Disposal instructions	Dispose in accordance with all applicable regulations. This material and its container must be disposed of as hazardous waste. Dispose of this material and its container to hazardous or special waste collection point. Incinerate the material under controlled conditions in an approved incinerator. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container.
Hazardous waste code	D018: Waste Benzene

US RCRA Hazardous Waste U List: Reference

Benzene (CAS 71-43-2)	U019
Hydrogen sulfide (CAS 7783-06-4)	U135
Naphthalene (CAS 91-20-3)	U165

Waste from residues / unused products	Dispose of in accordance with local regulations.
Contaminated packaging	Offer rinsed packaging material to local recycling facilities.

14. Transport information

DOT

UN number	UN3256
UN proper shipping name	Elevated temperature liquid, flammable, n.o.s. (Residual Fuel Oil)
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Label(s)	3
Packing group	III
Environmental hazards	
Marine pollutant	Yes
Special precautions for user	Not available.
Special provisions	IB1, T3, TP3, TP29
Packaging exceptions	None
Packaging non bulk	None
Packaging bulk	247

IATA

UN number	UN3256
UN proper shipping name	Elevated temperature liquid, flammable, n.o.s. (Residual Fuel Oil)
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	Not applicable.
Environmental hazards	Yes
ERG Code	3L
Special precautions for user	Not available.

IMDG

UN number	UN3256
UN proper shipping name	ELEVATED TEMPERATURE LIQUID, FLAMMABLE, N.O.S. (Residual Fuel Oil)
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	III
Environmental hazards	
Marine pollutant	Yes
EmS	F-E, S-D
Special precautions for user	Not available.
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations	This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200. All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Benzene (CAS 71-43-2)	Cancer Central nervous system Blood Aspiration Skin Eye respiratory tract irritation Flammability

CERCLA Hazardous Substance List (40 CFR 302.4)

Benzene (CAS 71-43-2)	LISTED
Hydrogen sulfide (CAS 7783-06-4)	LISTED
Naphthalene (CAS 91-20-3)	LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Chemical name	CAS number	Reportable quantity	Threshold planning quantity	Threshold planning quantity, lower value	Threshold planning quantity, upper value
Hydrogen sulfide	7783-06-4	100	500 lbs		

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
Polycyclic Aromatic Hydrocarbons	130498-29-2	0-10
Naphthalene	91-20-3	0-3
Benzene	71-43-2	<1

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Benzene (CAS 71-43-2)
Naphthalene (CAS 91-20-3)
Polycyclic Aromatic Hydrocarbons (CAS 130498-29-2)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Hydrogen sulfide (CAS 7783-06-4)

Safe Drinking Water Act (SDWA) Not regulated.

US state regulations WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Benzene (CAS 71-43-2)
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Fuel Oil No. 6 (CAS 68553-00-4)
Fuel oil, residual (CAS 68476-33-5)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
Sulfur (CAS 7704-34-9)

US. New Jersey Worker and Community Right-to-Know Act

Benzene (CAS 71-43-2)
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)
Fuel oil, residual (CAS 68476-33-5)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
Polycyclic Aromatic Hydrocarbons (CAS 130498-29-2)
Sulfur (CAS 7704-34-9)

US. Pennsylvania Worker and Community Right-to-Know Law

Benzene (CAS 71-43-2)
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)
Fuel oil, residual (CAS 68476-33-5)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)
Polycyclic Aromatic Hydrocarbons (CAS 130498-29-2)
Sulfur (CAS 7704-34-9)

US. Rhode Island RTK

Benzene (CAS 71-43-2)
Hydrogen sulfide (CAS 7783-06-4)
Naphthalene (CAS 91-20-3)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Benzene (CAS 71-43-2)
Clarified oils (Petroleum), catalytic cracked (CAS 64741-62-4)
Distillates (petroleum), heavy catalytic cracked (CAS 64741-61-3)
Fuel Oil No. 6 (CAS 68553-00-4)
Fuel oil, residual (CAS 68476-33-5)
Naphthalene (CAS 91-20-3)

International Inventories

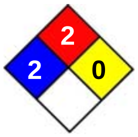
Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	No
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date	27-June-2013
Revision date	23-May-2014
Version #	02

NFPA ratings



References

ACGIH
EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

This material Safety Data Sheet (SDS) was prepared in accordance with 29 CFR 1910.1200 by Valero Marketing & Supply Co., ("VALERO"). VALERO does not assume any liability arising out of product use by others. The information, recommendations, and suggestions presented in this SDS are based upon test results and data believed to be reliable. The end user of the product has the responsibility for evaluating the adequacy of the data under the conditions of use, determining the safety, toxicity and suitability of the product under these conditions, and obtaining additional or clarifying information where uncertainty exists. No guarantee expressed or implied is made as to the effects of such use , the results to be obtained, or the safety and toxicity of the product in any specific application. Furthermore, the information herein is not represented as absolutely complete, since it is not practicable to provide all the scientific and study information in the format of this document, plus additional information may be necessary under exceptional conditions of use, or because of applicable laws or government regulations.

APPENDIX C

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	:	10/08/2020
REVISION NUMBER	:	5

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 Manager (CHSM) 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. There is currently no vaccine to prevent COVID-19.

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
- Bluish lips or face

How does COVID-19 spread?[1]

SARS-COV-2 spreads very easily from person to person during close contact.

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.

- When people with COVID-19 cough, sneeze, sing, talk, or breathe they produce respiratory droplets. These droplets can range in size from larger droplets (some of which are visible) to smaller droplets. Small droplets can also form particles when they dry very quickly in the airstream.
- Infections occur mainly through exposure to respiratory droplets when a person is in close contact with someone who has COVID-19.
- Respiratory droplets cause infection when they are inhaled or deposited on mucous membranes, such as those that line the inside of the nose and mouth.
- As the respiratory droplets travel further from the person with COVID-19, the concentration of these droplets decreases. Larger droplets fall out of the air due to gravity. Smaller droplets and particles spread apart in the air.
- With passing time, the amount of infectious virus in respiratory droplets also decreases.

SARS-CoV-2 can sometimes spread by airborne transmission under certain circumstances.

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.

- There is evidence that under certain conditions, people with COVID-19 seem to have infected others who were more than 6 feet away. These transmissions occurred within enclosed spaces that had inadequate ventilation. Sometimes the infected person was breathing heavily, for example while singing or exercising.
  - Under these circumstances, scientists believe the amount of infectious smaller droplet and particles produced by the people with COVID-19 became concentrated enough to spread the virus to other people. The people who were infected were in the same space during the same time or shortly after the person with COVID-19 had left.
- Available data indicate it is much more common for the virus that causes COVID-19 to spread through close contact with a person who has COVID-19 than through airborne transmission.[2]

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

---

[1] How COVID-19 Spreads https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html#edn1

[2] Scientific Brief: SARS-CoV-2 and Potential Airborne Transmission | CDC https://www.cdc.gov/coronavirus/2019-ncov/more/scientific-brief-sars-cov-2.html

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 CHSM 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.

Occupational Risk Pyramid for COVID-19

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).
- Morgue workers performing autopsies, which generally involve aerosol-generating procedures on the bodies of people who are known to have, or suspected of having, COVID-19 at the time of their death.

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 (e.g., doctors, nurses, and other hospital staff who must enter patients' rooms) exposed to known or suspected COVID-19 patients. (Note: when such workers perform aerosol-generating procedures, their exposure risk level becomes very high.)
- Medical transport workers (e.g., ambulance vehicle operators) moving known or suspected COVID-19 patients in enclosed vehicles.
- Mortuary workers involved in preparing (e.g., for burial or cremation) the bodies of people who are known to have, or suspected of having, COVID-19 at the time of their death.

Medium Exposure Risk

Medium exposure risk occupations/work activities include those that require frequent and/or close contact with (i.e., within 6 feet of) 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 contact with people known to be or suspected of being COVID-19 positive. 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 can include construction oversight that does not require close contact as well as sampling or gauging events performed by one worker.

6. COVID-19 HEALTH SCREENING

6.1. Roux Employees

All Roux employees are required to 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 and Corporate Health and Safety Manager.

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 is defined as someone who was within 6 feet of an infected person for at least 15 minutes or coming into direct contact with secretions (e.g., sharing utensils, being coughed on) from an infected person.*

- *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*

6.2. Subcontractors

In an effort to mitigate the risk of transmission of COVID-19, Subcontractors who shall perform work on-site 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.

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. 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 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.

7. SELF-ISOLATION & QUARANTINE

7.1. 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. As per CDC guidance, return from isolation has been broken out into two categories. The first includes confirmed or suspected COVID-19 individuals exhibiting symptoms, and the second includes those who have not had COVID-19 symptoms (i.e., asymptomatic), but tested positive and are under self-isolation. Both categories, along with strategies to return from home isolation, are outlined below.

People with COVID-19 under home isolation:

Accumulating evidence supports ending isolation and precautions for persons with COVID-19 using a symptom-based strategy. Specifically, researchers have reported that people with mild to moderate COVID-19 remain infectious no longer than 10 days after their symptoms began, and those with more severe illness or those who are severely immunocompromised remain infectious no longer than 20 days after their symptoms began. Therefore, CDC has updated the recommendations for discontinuing home isolation as follows:

1. **Persons with COVID-19 who have symptoms** and were directed to care for themselves at home may discontinue isolation under the following conditions:
   a. At least 10 days* have passed since symptom onset;
   b. At least 24 hours have passed since resolution of fever without the use of fever-reducing medications; and
   c. Other symptoms have improved.

* *A limited number of persons with severe illness may produce replication-competent virus beyond 10 days, which may warrant extending the duration of isolation for up to 20 days after symptom onset. Consultation with your healthcare provider will be warranted in such cases of severe illness.*

2. **Persons infected with SARS-CoV-2 who never develop COVID-19 symptoms** may discontinue isolation and other precautions 10 days after the date of their first positive RT-PCR test for SARS-CoV-2 RNA.

7.2. 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. If Roux employees meet the criteria to self-quarantine based on potential exposure/travel, they are required to self-quarantine for 14 days regardless of local/state exemptions. Even if you test negative for COVID-19 or feel healthy, symptoms may still appear 2 to 14 days after exposure to the virus.

7.2.1. Close Contact Quarantine

Employees who have come into close contact with someone who has COVID-19 are required to self-quarantine for 14 days following their last contact with the COVID-19 positive person. Close contact can be defined as being within 6 feet of someone who has COVID-19 for a total of 15 minutes or more, providing care at home to someone who is sick with COVID-19, having direct physical contact with COVID-19 individual, sharing utensils with COVID-19 individual, and being sneezed/coughed on by someone with COVID-19.

7.2.2. Travel Related Quarantine

All travel out of state must be communicated with the OM and/or Department Head prior to departure. Please note, some state/local entities require submissions of traveler health forms. It is expected all Roux employees will comply with such state/local travel requirements. All employees returning from international and/or cruise ship travel must quarantine for 14 days from the time they have returned home.

Personal Travel

Employees who will be traveling out of state are responsible for checking the local/state quarantine guidance for the regions they are traveling from and to in advance of travel and notifying their OM prior to traveling in order to evaluate the impact on the business. Based on state/local guidelines you may be required to quarantine for 14 days from the time you have returned home.

Work-Related Travel

The Project Team (i.e., PM & PP) and field staff who will be traveling are responsible for checking the local/state quarantine guidance for the regions they are traveling from and to in advance of travel and notifying their OM prior to traveling in order to evaluate the impact to the business. Additionally, health and safety considerations shall be reviewed by the OM in consultation with the CHSM regarding logistics and overnight accommodations. Based on state/local guidelines, you may be required to quarantine for 14 days from the time you have returned home.

8. WORKPLACE CONTROLS

During the project planning phase, worksite evaluations shall be carried out by the PP and OM in consultation with the CHSM to determine risk exposure levels for work activities. If it is determined there is a medium 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 8. 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 CHSM.

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 field work in areas where there is community-based transmission of COVID-19.

9. 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% ethanol or 70% isopropanol.
        - 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).
    - Stop handshaking—use and utilize other noncontact methods for greeting.
    - Do not work in areas with limited ventilation with other Site workers (e.g., small work trailer which lacks HVAC system). If working in a trailer, the following conditions must be met: limited to 4 workers, large enough to have the ability to apply social distance and has open windows and/or operational HVAC to ensure proper ventilation of the workspace.
    - Morning tailgate/safety meetings shall occur outside and not within work trailers.
        - Do not require employees or subcontractors to sign in using the same tailgate form. The Site Supervisor/SHSO should record names of those in attendance on the form.
        - If the Site has more than 10 workers, separate tailgate meetings should be performed in smaller groups.
    - Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g., nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically.
    - If receiving labware or other equipment disinfect to the extent feasible. If there are concerns for contaminating labware please wear appropriate PPE (e.g., gloves) to minimize contact.
    - Contact your lab/equipment vendor to confirm equipment is properly disinfected prior to being shipped.
    - Do not carpool with others (e.g., clients, coworkers).
    - For company owned vehicles limit sharing of vehicles with coworkers. If unable to limit sharing of company owned vehicles, properly disinfect 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 and disinfect frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboards, toilets, faucets, sinks, and field equipment (i.e., photo-ionization detector, field equipment).
    - **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.
    - For disinfection, diluted household bleach solutions, alcohol solutions with at least 70% alcohol, and most common EPA-registered household disinfectants should be effective.
        - Diluted household bleach solutions can be used if appropriate for the surface. Follow manufacturer’s instructions for application and proper ventilation. Check to ensure the product is not past its expiration date. Never mix household bleach with ammonia or any other cleanser. Unexpired household bleach will be effective against coronaviruses when properly diluted. Leave the solution on the surface for at least 1 minute.
            - Prepare a bleach solution by mixing:
                - 5 tablespoons (1/3 cup) bleach per gallon of water or
                - 4 teaspoons bleach per quart of water
    - 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.

10. CLOTH FACE COVERINGS

The CDC recommends the use of cloth face coverings in public settings where other social distancing measures are difficult to maintain, such as grocery stores and pharmacies, and especially in areas of significant community-based transmission. This recommendation is based on recent studies and an understanding that a significant portion of asymptomatic, as well as pre-symptomatic, individuals can shed the virus to others before showing symptoms. Studies indicate that COVID-19 can spread among people interacting in close proximity through speaking, coughing, or sneezing. The purpose of the cloth covering is NOT to provide protection to the wearer, but to protect the wearer from unknowingly infecting others if they are asymptomatic/pre-symptomatic. The use of cloth 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 cloth face coverings, when appropriate. Appropriate use is defined when local authorities or clients require the use of cloth 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 cloth face coverings that shall meet the basic requirements outlined by the CDC guidance.

Cloth Face Coverings should:

- Fit snugly but comfortably against the side of the face;
- Covers your nose and mouth and secure it under your chin;
- Include multiple layers of fabric;
- Allow for breathing without restriction; and
- Be able to be laundered and machine dried with no damage or change to shape.

When donning and doffing the cloth face covering, individuals should avoid touching their eyes, nose, and mouth. Following removal of the cloth face covering, employees should wash their hands immediately using the guidelines described in Section 8 above. Cloth face coverings should be routinely washed depending on the frequency of use.

The CDC does not recommend the use of gaiters or face shields. Evaluation of these face covers is on-going but effectiveness is unknown at this time. Masks with exhalation valves or vents should NOT be worn to help prevent the person wearing the mask from spreading COVID-19 to others (source control).

Note, the cloth face coverings recommended are not surgical masks or N-95 respirators. Those are critical supplies that must continue to be reserved for healthcare workers and other medical first responders, as recommended by current CDC guidance. Should there be a requirement for workers to be in respiratory protection (e.g., full-face respirator w/cartridges, P100, N95 respirators), it shall be addressed during the project pre-planning phase, which includes discussions with the PP and OM in consultation with CHSM.

11. HOTEL SELECTION PROCESS AND OVERNIGHT/REMOTE WORK

Hotel Selection

Due to the current COVID-19 situation, Roux is recommending overnight travel be limited to the extent possible. If there is a project requiring the overnight stay at a hotel, accommodations shall be made only after the hotel and hotel's location have been vetted in accordance with Roux's established guidance as defined below. The Project Team, which includes the Project Manager (PM) and PP along with the OM, in consultation with the CHSM, shall verify the hotel has appropriate protocols in place to limit the potential exposure and spread of COVID- 19 through proper cleaning and disinfection practices. Discussions with the hotel shall include, but are not limited to, measures taken to keep guests safe during their stay, guest room sanitization schedule, training of staff regarding disinfecting protocols using EPA-approved disinfectants, hotel staff fitness for duty requirements, etc. Some example questions are listed below. Following the initial hotel assessment by the Project Team, the OM and the CHSM shall review the hotel assessment findings prior to the CHSM's authorization that the hotel may be used by any Roux employees.

Sample Questions for Evaluating Hotels

1. Is there an established COVID-19 guidance/policy your location is following?
2. What additional measures are being implemented to keep workers and customers safe?; (e.g. signs/placards, social-distancing/mask reminders)
3. Is there a guest room sanitization schedule?
4. Have staff been trained on properly cleaning/disinfecting areas?
5. What types of disinfectants are in use at your location?
6. How are you evaluating staff fitness for duty? (e.g., temperature checks, not reporting to work when sick, etc.)

Employees staying overnight should abide by the following guidance:

- Ensure you properly disinfect your room upon arrival. This should include a wipe down of all commonly touched surfaces with an approved disinfectant. Use appropriate PPE (e.g., nitrile gloves) when disinfecting surfaces.
- Place the “Do Not Disturb” placard on the room while away and consider limiting hotel housekeeping service to the extent feasible (e.g., not having the room cleaned each day) to minimize potential secondary contact with others.
- Do not spend any more time in hotel common areas (i.e., lobby, hallways, etc.) than is necessary.
- Follow proper Infection Prevention Measures found within Section 8 above.
- Have meals in your hotel room after disinfecting outer package surfaces, as outlined in Section 8 above. Do not eat in public spaces or restaurants.
- If the hotel has a restaurant or café, do not have your meal in a common area; instead order food to be picked up or delivered to your room. If delivered, opt for contactless delivery (left outside the door, delivery person knocks and leaves). Always use your own pen if you need to sign something.
- Employees may also pick up food from takeout locations, order groceries or food for delivery to the hotel. Call local restaurants to order food for delivery (call the hotel lobby for recommendations) or use food ordering apps. Some apps have options for contactless delivery.

12. TRANSPORTATION-RENTAL CARS AND ROUX-OWNED VEHICLES

Rental Cars

Due to the current COVID-19 situation, Roux recommends rental car usage be limited to the extent possible. If there is a project requiring the use of a rental car (e.g. truck/van), accommodations shall be made only after the rental car company and their store’s location have been vetted in accordance with Roux’s established guidance, as defined below. The Project Team (PM and PP) and OM in consultation with the CHSM shall verify the rental company where you are picking up your vehicle has appropriate protocols in place to limit the potential exposure and spread of COVID- 19 through proper cleaning and disinfection practices. Discussions with the rental car company shall include, but are not limited to, measures to be taken to keep customers safe during pickup/drop-off, rental car disinfection protocols, training of staff regarding disinfecting protocols using EPA-approved disinfectants, rental car company staff fitness for duty requirements, etc. Some example questions are listed below. Following the initial rental car company store assessment by the Project Team, the OM and the CHSM shall review the rental car company assessment findings prior to the CHSM’s authorization that the rental car company store may be used by any Roux employees.

Sample Questions for Evaluating Rental Car Companies

1. Is there an established COVID-19 guidance your location is following?
2. What additional measures are being implemented to keep workers and customers safe?
3. Is there a car sanitization schedule?

4. Have staff been trained on properly cleaning/disinfecting vehicles?
5. What types of disinfections are in use at your location?
6. How are you evaluating staff fitness for duty? (e.g., temperature checks, not reporting to work when sick, etc.)

Upon vehicle pickup, employees shall don nitrile gloves and safety glasses and clean/disinfect all high-touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (following manufacturer's instructions). Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. Due to social distancing requirements, personnel shall not carpool to destinations.

Roux-Owned Vehicles

Due to the current COVID-19 situation, Roux-owned vehicles should be dedicated to individual employees to the extent feasible, and if authorized by the OM. In the case this cannot be accommodated, employees shall don nitrile gloves and safety glasses, and clean/disinfect all high-touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (following manufacturer's instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. Due to social distancing requirements, personnel shall not carpool to destinations.

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.

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 14 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 14 days?

   *Close contact is defined as someone who was within 6 feet of an infected person for at least 15 minutes or coming into direct contact with secretions (e.g. sharing utensils, being coughed on) from an infected person.
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 14 days?
4. Have you tested positive for COVID-19 within the last 14 days?

Please list the crew member's names on site for the day.

1.	9.
2.	10.
3.	11.
4.	12.
5.	13.
6.	14.
7.	15.
8.	16.

APPENDIX B

Job Safety Analysis-Working in Areas Affected by COVID-19

JOB SAFETY ANALYSIS Ctrl. No. CVD-19	DATE: 04/16/2020	☒ 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	CHSM

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST	☐ GOGGLES	☐ AIR PURIFYING RESPIRATOR	☒ GLOVES – Leather/cut-resistant in field and nitrile as needed
☒ HARD HAT – In field	☐ FACE SHIELD	☐ SUPPLIED RESPIRATOR	
☐ LIFELINE / BODY HARNESS	☐ HEARING PROTECTION	☒ PPE CLOTHING – High visibility vest in field	
☒ SAFETY GLASSES – In field	☒ SAFETY SHOES – Steel/composite toe in fie		☐ OTHER

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. • Use the same vehicle every day and do not share with co-workers. • Verify workers/other people are not approaching vehicle prior to exiting the vehicle. Maintain 6' of distance from others. • DO not valet your car or allow others to use your car. If necessary, don nitrile gloves and safety glasses and clean/disinfect all high touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (follow manufacturer's instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. **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 PPE and apply social distancing (6 ft). Use proper donning and doffing procedures for nitrile gloves. 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 disinfect your room upon initial arrival and returning each day. Disinfect all surfaces of your room with an appropriate disinfectant using nitrile gloves. Use proper donning and doffing procedures for nitrile gloves. • 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. Minimize, or avoid entirely, time spent in hotel common areas (i.e., the lobby, dining areas, gyms, etc.). Wash hands or use hand sanitizer often.

---

[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".

3. Tailgate Meeting	**Exposure:** Becoming infected or infecting co-workers	• Must occur outside or remotely (i.e. video or conference call). • Maintain at least a 6+ ft distance between you and others. • Discuss primary infection prevention measures listed below. • Do not require employees or subcontractors to sign in, the Site Supervisor shall record names on the attendance form. • If the Site has more than 10 workers, separate tailgate meetings should be performed. • 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.
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 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. • Do not shake hands or touch others. • Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g. nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically (See Appendix B of Roux Interim H&S Guidance for proper glove removal). • If anyone is coughing or sneezing 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. • Disinfect work surfaces/areas with approved disinfectant you're responsible for (ex: desk, office doorknob, computer, etc.) at least once at the beginning of your shift and at least once at the end of your shift with either sanitizing wipes or disinfectant spray. • Phones should be operated hands free to extent feasible. Sanitize your phone on a regular basis. Disinfection should also take place whenever suspected contaminated material comes in contact with any work surfaces/areas. Wash hands or use hand sanitizer immediately after. • 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. 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% ethanol or 70% isopropanol. 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).
  - Stop handshaking/touching others and use caution when accessing public spaces.
- Clean and disinfect 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.

---

[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

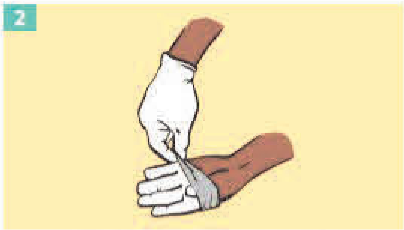
How to Remove Gloves

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

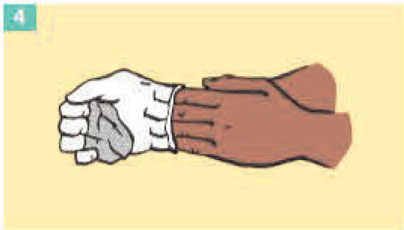


Peel the glove away from your body, pulling it inside out.

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 D

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**

TABLE OF CONTENTS

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 °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 E

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**

TABLE OF CONTENTS

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 F

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**

TABLE OF CONTENTS

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 G

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**

TABLE OF CONTENTS

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 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
☐Restricted Work
☐First Aid
☐Lost Time
☐Medical Treatment

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)

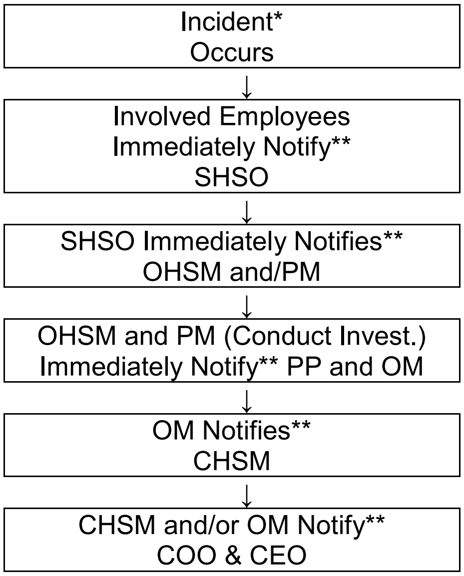
1. CAMP
2. Construction
3. Drilling
4. Driving
5. Excavation/Trenching
6. Gauging
7. O&M
8. Other Soil Work (e.g. Compaction)
9. Sampling
10. Site Walk/ Inspection
11. Subsurface Clearance
12. Trucking
13. Waste Management
14. Work Area Preparation
15. Other

***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 Sys
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.

APPENDIX H

Community Air Monitoring Plan (CAMP)

Community Air Monitoring Plan

Sendero Verde Redevelopment Project – Parcel A
Block 1617, Lot 120
New York, New York 10029

January 18, 2021

Prepared for:

SV-A Owners LLC
Sabrina Barker
551 Fifth Avenue, 23rd Floor
New York, New York 10176

Prepared by:

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

Environmental Consulting
& Management
+1.800.322.ROUX
rouxinc.com

Table of Contents

Table

Appendix

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux) on behalf of Sendero Verde Redevelopment Project – Parcel A, (the “Requestor”), have developed a project specific Community Air Monitoring Plan (CAMP) to implement real time monitoring at the Site, which occupies Tax Lot 120 of Tax Block 1617, during remedial construction 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’s (NYSDOH) Generic Community Air Monitoring Plan guidance document.

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

- 1.1 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 of the excavation activities during all ground intrusive activities. An upwind monitoring station will be set up adjacent to where the excavation is occurring. The VOC monitoring equipment will be located at temporary monitoring stations that will be established daily based on Site logistics and weather conditions. 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 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 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 (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 at temporary particulate monitoring stations set up at the sidewalk at upwind and downwind locations. 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 MIE Data Ram monitors or equivalent. A minimum of one (1) upwind and one (1) downwind monitor will be deployed each day, equipped with an omni-directional sampling inlet and a PM-10 sample head. 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 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 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 onsite 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 excavation 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. NYSDEC and NYSDOH will be notified of all 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 onsite 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 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

Action Limit Summary for VOCs and Particulates

Table 1. Action Limit Summary for VOCs and Particulates, Sendero Verde Redevelopment Project - Parcel A, New York, NY

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: Sendero Verde Redevelopment Project - Parcel A
Tax Block 1617 Lot 120

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

APPENDIX F

Quality Assurance Project Plan/ Field Sampling Plan

ROUX

Quality Assurance Plan/ Field Sampling Plan

Sendero Verde Redevelopment Project – Parcel A
Tax Block 1617 of Tax Lot 120
New York, New York
NYSDEC BCP Site Number C231135

December 28, 2022

Prepared for:

SV-A Owners LLC

Prepared by:

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

Environmental Consulting
& Management
+1.800.322.ROUX
rouxinc.com

Table of Contents

Tables

Figures

Attachments

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux), on behalf of SV-A Owners LLC has prepared this Quality Assurance Project Plan/Field Sampling Plan (QAPP/FSP) to describe the measures that will be taken to ensure the data generated during the Site Management Plan (SMP) for the Sendero Verde Redevelopment Project – Parcel A Site occupying Tax Block 1617, Lot 120, New York, New York (Site, Figures 1 and 2) are of quality sufficient to meet project-specific data quality objectives (DQOs). This QAPP/FSP also includes field sampling procedures.

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 sampling tasks.

This QAPP/FSP was prepared in accordance with the NYSDEC's DER-10 and provides guidelines and procedures to be followed by field personnel during performance of media sampling. 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 laboratory analysis (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 sampling program is designed to meet the data quality objectives (DQOs) set forth in the DER-10. Specifically, analytical parameters selected for each sample, as described in Section 4, are comprehensive, and are intended to meet the following objectives:

- Analyze endpoint documentation samples;
- Analyze soil designated for offsite disposal for parameters required by the selected disposal facility;
- Analyze offsite backfill/on-Site reuse soil to evaluate its suitability for use as backfill

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

Ms. Noelle Clarke, P.E. of Roux 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 Ms. Noelle Clarke, 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 and future remedial program for the Site. The Remedial Engineer will certify that activities were observed by qualified environmental professionals under supervision as well as any other relevant provisions of ECL 27-1419 have been achieved in full conformance with the Site Management Plan.

Project Manager

Brandon Vella of Roux will serve as Project Manager. The Project Manager is responsible for defining project objectives and bears ultimate responsibility for the successful completion of the work. This individual 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 is to be determined. 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

Laboratory analysis will be completed by Alpha Analytical Laboratories of Westborough, MA and Mansfield, MA, NYSDOH Environmental Laboratory Accreditation Program (ELAP)-certified laboratories (11148 and 11627, respectively). The Laboratory Project Manager will be assigned at a later date. 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 an acceptable laboratory report is prepared and submitted. The Laboratory Project Manager reports to the Field Team Leader.

Quality Assurance Officer

David Kaiser, P.E. 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 the data collection is conducted in accordance with the QAPP/FSP. 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, Analytical Suites, and Frequency

The media to be sampled during future activities on-Site may include soil and backfill materials. A summary of field and laboratory quality control sampling frequencies is presented in Table 1. Sample preservations, holding times, and containers for environmental samples are presented in Table 2. Specifics regarding the collection of samples for each task are provided in Section 5 of this QAPP/FSP.

4.1 Documentation Soil Sampling

Documentation samples include the proposed samples to be collection during the future construction. The proposed samples to be collected are described below.

Bottom Sampling

If required for any future excavation work in the Track 2 or Track 4 Restricted Residential portions of the Site, bottom documentation sampling will be conducted at a frequency of one sample per approximately 900 square feet of excavation area. The frequency of bottom sampling proposed for this alternative is in accordance with guidance provided in NYSDEC DER-10 5.4 for excavations 20 to 300 feet in perimeter.

Sidewall Sampling

If required for any future excavation work in the Track 2 or Track 4 Restricted Residential portions of the Site, sidewall sampling will be conducted at a frequency of one sample per 30 linear feet of sidewall. The sidewall samples will be biased toward any observed impacts (i.e., staining, odor, elevated photoionization detector [PID] readings). If no impacts are observed, the sidewall samples will be collected at half the excavation depth). The frequency of sidewall sampling proposed for this alternative is consistent with guidance provided in NYSDEC DER-10 5.4.

Anaytical Sampling Parameters

The bottom and sidewall documentation samples will be tested for the TCL/Part 375 plus 30/ TAL (TCL + 30/TAL) list of parameters including:

- TCL/Part 375 VOC + 10 Tentatively identified compounds (TICs);
- TCL/Part 375 Base neutral acids (BNA)/SVOCs + 20 TICs;
- TCL/Part 375 Pesticides;
- TCL/Part 375 Herbicides;
- TCL/Part 375 PCBs;
- TAL/Part 375 Metals (including hexavalent chromium);
- Total Cyanide; and
- Emerging Contaminants *

*ECs list includes 1,4-Dioxane as well as the 40 Per- and Polyfluoroalkyl Substances (PFAS) listed in the most recent November 2022 NYSDEC guidance *Sampling, Analysis, and Assessment of Per-and Polufluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs* (NYSDEC November 2022 Guidance), included as an attachment to this QAPP/FSP. 1,4-Dioxane in soil will be analyzed by USEPA Method 8270D. PFAS in soil will be analyzed by Draft USEPA Method 1633. The 40 PFAS are shown in the table below:

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

Group	Chemical Name	Abbreviation	CAS Number
	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
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

4.2 Offsite Backfill/On-Site Reuse Soil Sampling

For offsite backfill/on-Site reuse soil materials requiring chemical testing, the following samples shall be collected:

- One sample for pre-qualification chemical testing at the source location, including the following:
  1. Chemical testing shall be performed at a minimum for the parameters listed in Table 375-6.8(b) of the latest revision of Part 375. Samples will be analyzed by the following analytical methods: Herbicides by USEPA method SW-846 8151A; Pesticides and PCBs by USEPA methods SW-846 8081B/8082A; VOCs by USEPA method SW-846 8260C; SVOCs by USEPA method SW-846 8270D; Arsenic, barium, beryllium, cadmium, copper, cyanide, lead, manganese, nickel, selenium, silver, and zinc by USEPA method SW-846 6010D/6010C; Total mercury by USEPA method SW-846 7471B; Total chromium, hexavalent chromium, and trivalent chromium by USEPA method SW-846 7196A; 1,4-Dioxane by USEPA method 8270D; and Per- and Polyfluoroalkyl Substances (PFAS) by Draft USEPA Method 1633.
  2. Backfill/on-Site reuse soil materials excluding those materials that do not require sampling as described below, shall meet criteria presented in Section 2.0.

3. Backfill/on-Site reuse soil materials that exceed the criteria presented in Section 2.0 shall not be imported to the Site without prior approval of the NYSDEC.
4. The backfill/on-Site reuse soil material will be free of extraneous debris or solid waste.
5. If the NYSDEC agrees that the material originated from a virgin source, then a minimum of one sample (i.e., the pre-qualification sample) will be collected and analyzed per source.

- If the source is not virgin, the sampling frequency will comply with DER-10 Table 5.4(e)10 shown below:

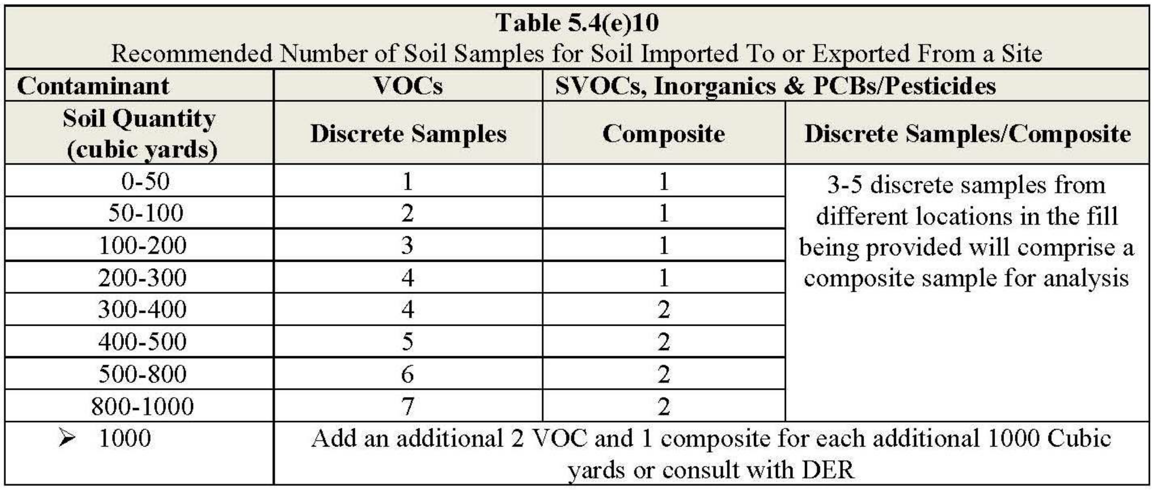


Table 5.4(e)10

Recommended Number of Soil Samples for Soil Imported To or Exported From a Site

Contaminant	**VOCs**	**SVOCs, Inorganics & PCBs/Pesticides**	
Soil Quantity (cubic yards)	**Discrete Samples**	**Composite**	**Discrete Samples/Composite**
0-50	1	1	3-5 discrete samples from different locations in the fill being provided will comprise a composite sample for analysis
50-100	2	1	
100-200	3	1	
200-300	4	1	
300-400	4	2	
400-500	5	2	
500-800	6	2	
800-1000	7	2	
➢ 1000	Add an additional 2 VOC and 1 composite for each additional 1000 Cubic yards or consult with DER		

The source of the offsite backfill/on-Site reuse soil must be documented by the supplier, including the location where the fill/on-Site reuse soil was obtained and a brief history of the site that is the source of the fill.

Samples of offsite backfill/on-Site reuse soil will be analyzed for the following parameters:

- Herbicides by USEPA method SW-846 8151A.
- Pesticides and PCBs by USEPA methods SW-846 8081B/8082A.
- VOCs by USEPA method SW-846 8260C.
- SVOCs by USEPA method SW-846 8270D.
- Arsenic, barium, beryllium, cadmium, copper, cyanide, lead, manganese, nickel, selenium, silver, and zinc by USEPA method SW-846 6010D/6010C.
- Total mercury by USEPA method SW-846 7471B.
- Total chromium, hexavalent chromium, and trivalent chromium by USEPA method SW-846 7196A.
- 1,4-Dioxane by USEPA method 8270D.
- Per- and Polyfluoroalkyl Substances (PFAS) by Draft USEPA Method 1633.

The parameters to be sampled are listed on Table 375-6.8(b) of the latest revision of Part 375. QA/QC samples are not required for backfill/on-Site reuse soil samples. All PFAS compounds in soil will be analyzed and reported to 0.5 microgram per kilogram (ug/kg). 1,4-Dioxane will be analyzed and reported to 0.1 miligram per kilogram (mg/kg).

The following materials may be imported, without chemical testing, to be used as backfill beneath pavement, buildings or as part of the site cover, provided that it contains less than 10 percent by weight material that would pass through a size 80 sieve and consists of:

- gravel, rock or stone, consisting of virgin material from a permitted mine or quarry; or
- recycled concrete or brick from a NYSDEC registered construction and demolition debris processing facility if the material conforms to the requirements of Section 304 of the 2002 New York State Department of Transportation Standard Construction and Materials Volume 1.

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 (i.e., soil and backfill material). Additional details regarding sampling procedures and protocols are described in Roux's relevant Standard Operating Procedures (SOPs), which are provided in Attachment 2.

5.1 Soil Sampling

Details for the collection of soil samples is provided below. Additional necessary precautions will be taken when sampling for ECs in the field, incuding but not limited to:

- Using the proper field clothing or personal protective equipment (i.e. no materials will contain Gore-Tex or Tyvek);
- Avoid 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 cubes for sample presevation and only Alconox for decontamination.

5.1.1 Soil Documentation Sampling

Soil documentation samples 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 ecording 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. 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 2.

5.2 Offsite Backfill/On-Site Reuse Soil Sampling

All imported backfill/on-Site reuse soil material samples will be collected using pre-cleaned stainless steel sampling tools (i.e., trowels, spatulas, etc.) or new Ziploc bags. As noted above, waste characterization samples will be collected as required by the selected disposal facility. In general, where composite samples are required for waste characterization or offsite fill/on-Site reuse soil material samples, composite samples will be collected from a minimum of three locations across the stockpiled materials. The exception is for VOC samples, which will be collected as grab samples.

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 4.0 of this QAPP/FSP. The types of containers, volumes, and preservation techniques for the aforementioned testing parameters are presented in Table 2.

6.2 Sample Custody Documentation

The purpose of documenting sample custody is to ensure 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 portions, 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 fieldwork 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 laboratory.

6.3 Sample Shipment

Laboratory analysis will be completed by Alpha Analytical Laboratories of Westborough, MA and Mansfield, MA, NYSDOH Environmental Laboratory Accreditation Program (ELAP)-certified laboratories (11148 and 11627, respectively). 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 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 appropriately at the bottom of the cooler to act as a cushion for the sample containers.
6. Arrange containers in the cooler so 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

James Hauri, a data validator who is independent of the project team, will review the analytical data for quality assurance and quality control in accordance with NYSDEC standards. The professional profile for James Hauri is provided in Attachment 1. A laboratory SOP for analysis of PFAS is included in Attachment 2.

The primary intended use for the data is to confirm that it meets the requirements of the SMP. The primary DQO of the soil program, therefore, is that data be accurate and precise, thus, 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.

Table 1 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 2 lists the preservation, holding times and sample container information.

All “assessment” analyses (i.e., TCL/Part 375 plus 30/ TAL and ECs) 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) and recent updated procedures enacted in November 2018. A Data Usability Report will be prepared meeting the requirements in Section 2.2(a)1.ii and Appendix 2B of DER-10 for all data packages generated. The DUSR will be prepared by James Hauri, a data validator who is independent of the project team. Validator’s resume is included in Attachment 1.

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).

7.1 Decontamination

In an attempt to avoid the spread of contamination, all 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 2. 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.

Only "PFAS-free" water will be used for decontamination of sample equipment onsite. Only Alconox will be used as decontamination detergent (Liquinox shall not be used).

7.2 Waste Handling and Disposal

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

Respectfully submitted,

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

Brandon Vella
Project Scientist

Noelle Clarke, P.E.
Principal Engineer

TABLES

Table 1. Field and Laboratory QC Summary

QC Check Type	Minimum Frequency	Use
Field QC		
Duplicate	1 per matrix per 20 samples or SD	Precision
Trip Blank	1 per VOC cooler	Sensitivity
Field Blank (non-PFAS)	1 per matrix per 20 samples	Sensitivity
Field Blank (PFAS)	1 per matrix per day	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

Notes:

* SDG - Sample Delivery Group - Assumes a single extraction or preparation
** Provided to lab by field sampling personnel
PFAS - Per- and Polyfluoroalkyl Substances

Table 2. Preservation, Holding Times and Sample Containers

Analysis	Matrix	Bottle Type	Preservation(a)	Holding Time(b)
TAL/Part 375 Metals (total)	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	180 days
Mercury	Soil	2 oz wide mouth glass, teflon lined cap	Cool to 4°C	28 days
Hexavalent Chromium	Soil	2 oz wide mouth glass, teflon lined cap	Cool to 4°C	30 days from sample collection to extraction; 7 days following extraction
Total Cyanide	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days from sample collection
PFAS via EPA 1633	Soil	One 8 oz HDPE bottle One 2 oz HDPE bottle	Cool to 4°C	14 days to extract, 40 days to analysis
1,4-Dioxane via 8270D	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
Target Compound List (TCL)/Part 375				
TCL/Part 375 Volatile Organic Compounds (VOCs)	Soil	Three 5 gram Encore samplers One 2 oz plastic bottle, teflon lined cap	Cool to 4°C	48 hours, or 14 days if extruded into sealed vial and either frozen to -7 degrees C or extruded into methanol
TCL/Part 375 Semivolatile Organic Compounds (SVOCs)	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
TCL/Part 375 Pesticides	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
TCL/Part 375 Herbicides	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis
TCL/Part 375 Polychlorinated biphenyls (PCBs)	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 4°C	14 days to extract, 40 days to analysis

(a) All soil and groundwater samples to be preserved in ice during collection and transport

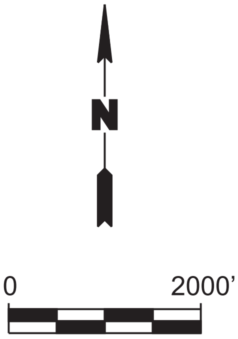
(b) Days from date of sample collection.

TAL - Target Analyte List
PFAS - Per- and Polyfluoroalkyl Substances
TCL - USEPA Contract Laboratory Program Target Compound List
USEPA - United States Environmental Protection Agency

FIGURES

QUADRANGLE LOCATION

SOURCE:
USGS; 2013, Central Park, NY
7.5 Minute Topographic Quadrangle



Title:

SITE LOCATION MAP

SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

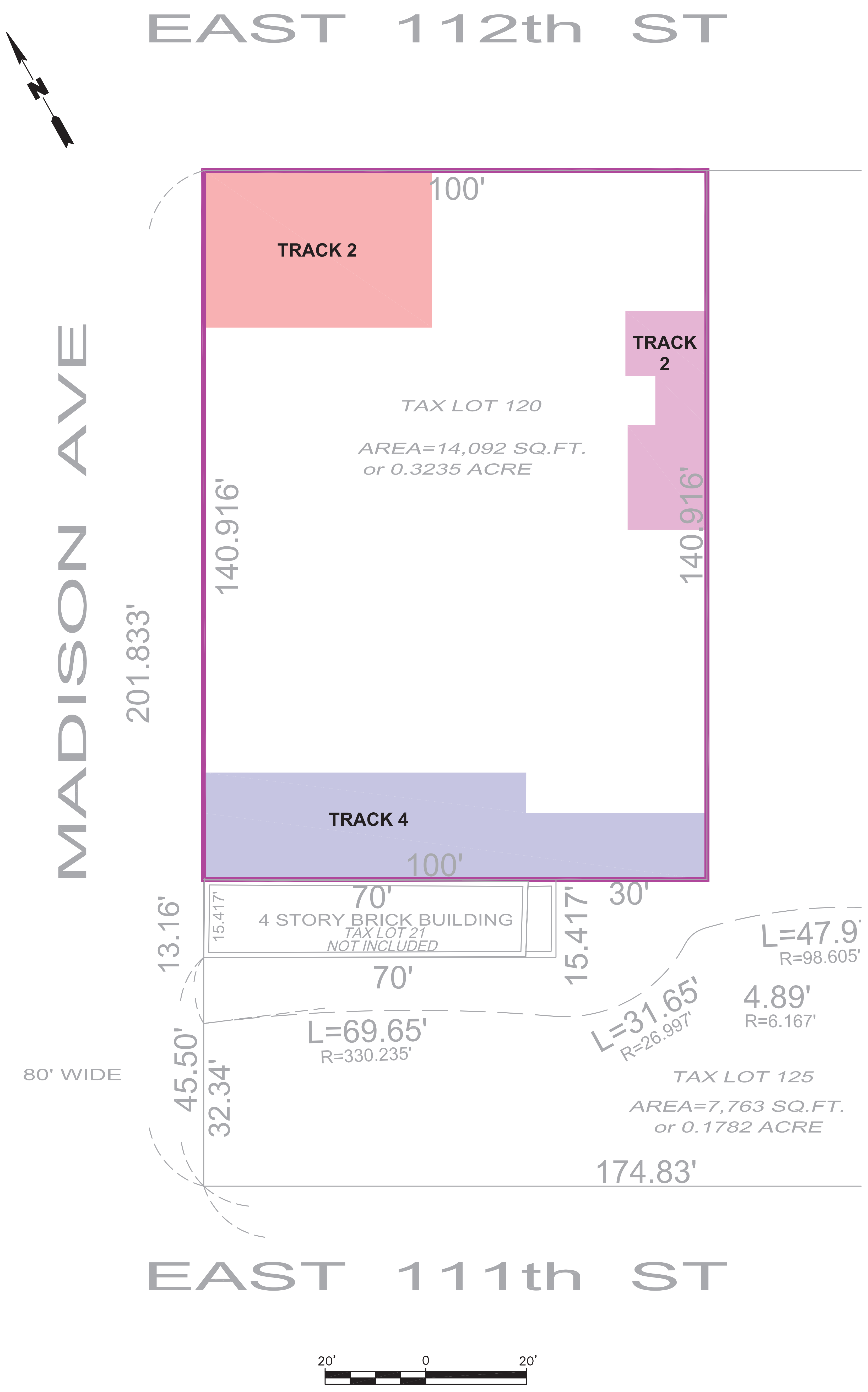
Prepared for:

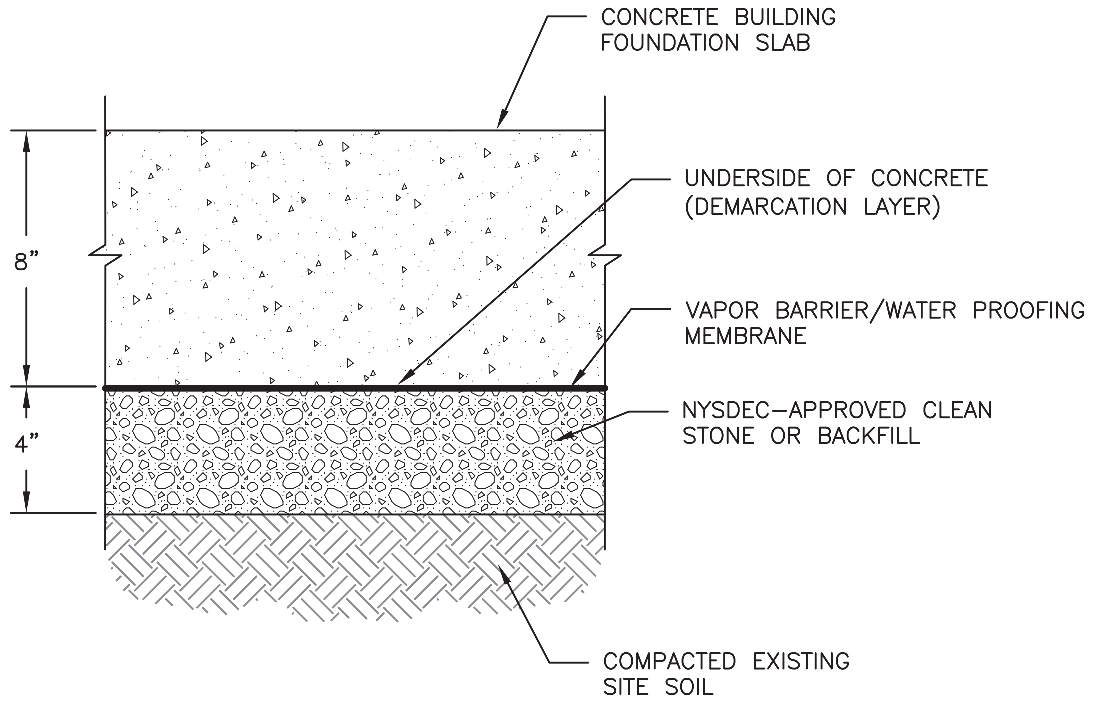
SV-A OWNERS LLC

ROUX

Compiled by: N.C.	Date: 21DEC20	FIGURE
Prepared by: G.M.	Scale: AS SHOWN	1
Project Mgr: N.C.	Project: 2984.0002Y002	
File: 2984.0002Y120.01.CDR		

V:\CAD\PROJECTS\2984Y\0002Y\120\2984.0002Y120.01.CDR





① AS–BUILT SITE COVER SYSTEM: CONCRETE BUILDING FOUNDATION

SCALE: NOT TO SCALE

LEGEND

—	BCP SITE BOUNDARY
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
BCP	BROWNFIELD CLEANUP PROGRAM
■	TRACK 4 – LIMITS OF SITE COVER SYSTEM COMPRISED OF CONCRETE BUILDING FOUNDATION AND SUB–BASE AGGREGATE BACKFILL. SEE DETAIL 1.
■	TRACK 2 – RESTRICTED RESIDENTIAL
■	TRACK 2 – RESIDENTIAL

NOTE

1. BASEMAP ADAPTED FROM SURVEY NO. 65967–2 PREPARED BY MONTROSE SURVEYING CO., LLP, DATED FEBRUARY 1, 2019.
2. THE BUILDING FOOTPRINT COVERS THE ENTIRE BCP SITE.

NO.	DATE	REVISION DESCRIPTION	INT.

PROJ. ENGINEER: N.C.	DRAWN BY: B.H.C.
DESIGNED BY: N.C.	CHECKED BY: B.V.
DRAWING SCALE: AS SHOWN	PLOT SCALE: 1:1
DRAWING DATE: 08AUG22	PRINT TYPE: COLOR
OFFICE: NY	PAPER SIZE: ARCH D
PROJECT NO.: 2984.0002Y002	
DRAWING FILE: 2984.0002Y152.03.DWG	

ROUX

Roux Environmental
Engineering and Geology, D.P.C.
209 SHAFTER STREET ISLANDIA NEW YORK 11749
(631) 232-2600

PROJECT NAME:
SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

PROJECT FOR:
SV-A OWNERS LLC

TITLE:
SITE MAP

FIGURE
2

V:\CAD\PROJECTS\2984\0002Y\152\2984.0002Y152.03.DWG

ATTACHMENTS

1. Professional Profiles
2. Standard Operating Procedures, Laboratory Detection Limits for Emerging Contaminants, and NYSDEC Guidance for Sampling Emerging Contaminants

ATTACHMENT 1

Professional Profiles

Noelle M. Clarke, P.E.
Principal Engineer

TECHNICAL SPECIALTIES

Feasibility studies, pilot testing, remedial design, implementation, construction management, and startup evaluations for remediation of soil, groundwater, soil vapor and sediment. Phase I/Phase II Environmental Site Assessments (ESA). Extensive experience at brownfields redevelopment sites, former industrial facilities, and public works facilities. Evaluation and design of storm water drainage systems. Evaluation, design, and construction management for new and existing wastewater treatment processes.

EXPERIENCE SUMMARY

Thirty-one years' experience: Principal Engineer/Senior Engineer at Remedial Engineering, P.C./Roux Associates; Project Engineer at Camp Dresser & McKee.

CREDENTIALS

B.S. – Civil Engineering, Manhattan College, 1991
M.E. – Environmental Engineering, Manhattan College, 1994
Professional Engineer in New York.

PAPERS AND PRESENTATIONS

Sparging Targets Submerged Residual Saturation Contamination, written with D. Bennett and L. Buchanan. Presented at the 66th New York Water Environment Federation Association Annual Meeting, New York, New York, February 1994.

Suffolk County Wetlands – Flow Augmentation Needs Study, written with M. A. Taylor and R. Southard. In Proceedings of the Annual Meeting, Hydrology and Hydrogeology of Urban and Urbanizing Areas. American Institute of Hydrology, April 1996.

KEY PROJECTS

- Principal Engineer providing due diligence support for real estate transactions on multiple projects in the New York metropolitan area. Projects have included multi-family housing (both affordable and market rate), retail/ commercial, community services and industrial properties. Services have included Phase I and Phase II ESAs.

- Principal Engineer for a Brownfield redevelopment of a property adjacent to a dry cleaning solvent distribution facility in Brooklyn, New York under the NYSDEC BCP. The site was previously a warehouse built on a former freight railyard that serviced the dry cleaning solvent facility. Offloading spillage on site and migration from the offsite facility resulted in significant soil, groundwater, and vapor contamination with chlorinated VOCs. The site was developed into multifamily housing with first floor retail use. Pre-remediation and posts-remediation Phase I ESAs were prepared by Roux Associates. The remedy, as summarized in the Remedial Action Work Plan (RAWP), consisted of soil hot spot removal, a physical barrier to limit on site migration, a permeable reactive wall to mitigate offsite migration, and a sub slab depressurization system. Roux Associates, under the direction of Ms. Clarke provided full time oversight of the remediation and prepared the Final Engineering Report and Site management Plan. The Certificate of Completion for the Site was obtained in October 2015 and Roux Associates is currently providing post-remediation monitoring services.

- Principal Engineer for a Brownfield redevelopment in Brooklyn, New York at a mixed-use multifamily housing/neighborhood retail complex with a former onsite dry cleaner under the NYSDEC BCP. There is soil, groundwater, and vapor contamination from chlorinated VOCs from the former onsite dry cleaner, as well as groundwater contamination from offsite dry cleaners. The remedy, described in the Remedial Action Work Plan prepared by Roux, consisted of hot spot soil removal, *in situ* groundwater treatment and a sub slab depressurization system for vapor mitigation in the existing buildings. The NYSDEC accepted the Final Engineering Report prepared by Roux Associates and the Site received a Certificate of Completion from NYSDEC in 2016.

- Principal Engineer for a complex dredging project for a major petroleum company on the Allegheny River in New York. The goal of the project is to remove 1,000 tons petroleum impacted sediments from the river. Work includes Site investigation, remedial investigation, alternatives evaluation, remedial design, planning and extensive regulatory permitting with multiple federal, state and local agencies.

- Principal Engineer for the alternatives evaluation, remedy selection, regulatory negotiation, preparation of design documents (drawings, specifications and permit applications) and permitting for all remedial components in support of redevelopment at a former metals manufacturing site in Staten Island, New York under the NYSDEC Voluntary Cleanup Program (VCP). The remedy included dredging and onsite disposal of stream sediments; consolidation and capping of fill material across the site; in-place abandonment of the Site's former sewer system; installation of drainage swales for storm water management; and wetland bank stabilization and mitigation/restoration. The work included a significant permitting component from multiple federal, state, and New York City regulatory agencies, including USACE, National Marine Fisheries, NYSDEC, NYSDOS, New York City Department of Environmental Protection, and Department of City Planning.

- Principal Engineer for the design, bidding, contractor selection, and remedial construction phase at a former metals manufacturing facility in Staten Island under the NYSDEC VCP. Responsibilities included finalizing biddable construction documents, issuing to bidders, preparing addenda and evaluating bids for presentation to the client. Following contractor selection Roux was heavily involved in coordinating with the client, regulators and contractor for mobilization to the site in late 2006. During the construction Ms. Clarke provided support to the onsite construction manager regarding field changes, design revisions to account for unexpected conditions and contractor questions. The Final Engineering Report summarizing the construction activities was accepted by NYSDEC.

- Principal engineer for permitting of remedial activities at a metals manufacturing site in Staten Island, New York under the NYSDEC VCP. Required permits and regulatory approvals for the project included a Joint Permit from the USACE and NYSDEC for dredging of Mill Creek, bank stabilization and construction activities in the wetlands; a NYSDEC SPDES equivalency permit for discharge of treated water to the Arthur Kill, a New York State Department of State Coastal Management Program (CMP) Federal Consistency Assessment; a New York City Waterfront Revitalization Program Consistency Assessment, a modification of topography authorization from New York City Department of City Planning; and a New York City Department of Environmental Protection permit for temporary discharge to a combined sewer. Also required by the USACE and National Marine Fisheries, was preparation of an Essential Fish Habitat Study, in support of the Joint Permit application. Permitting activities included preparation of the various permit applications, forms and supporting documentation, as well as follow up meetings and correspondence to finalize the authorizations.
- Principal-in-Charge of an investigation and remediation project at a former petroleum refinery and current distribution facility located in Buffalo, New York. The site entered the NYSDEC BCP in 2006. Roux Associates completed the BCP application and supported the application process. The work included assessing and remediating the potential environmental impacts associated with historical Site operations. These activities have included preparing multiple work plans and directing the activities of another consultant performing the fieldwork and preparing reports of results for field investigations including soil boring and sampling, well installation and groundwater sampling, aquifer pump testing, and groundwater/separate phase modeling. An *in situ* chemical oxidation system was designed, installed and was operated as an IRM to remediate and area of free product and impacted groundwater discharging to the Buffalo River in OU-4.
- For the same petroleum Site in Buffalo, New York, multiple Alternatives Analysis Reports (to document analysis of engineering options and remedy recommendation), Remedial Action Work Plans and remedial design documents have been prepared to address the environmental impacts associated with the five Operable Units (OU) on the Site. Remedial construction for OU-1 was completed in 2007 and included excavation and disposal of impacted soil. The Final Construction Certification Report for OU-1 was accepted by the NYSDEC. The Alternatives Analysis Report and Remedial Design for OU-4 were submitted and approved by NYSDEC. The remedy for OU-4 included excavation and onsite consolidation of river sediments and site soil, stabilization of 1,400 linear feet of river embankment using tiered slopes, rip rap, and reinforced bioengineering, slurry wall groundwater containment, low permeability capping, a stormwater collection system and constructed wetland treatment for stormwater. Various vegetative measures were incorporated into the design in order to promote vegetative growth and enhance wildlife habitats. The remedial construction was completed in 2013 and 2014 and preparation of the Final Construction Completion Report was competed in 2015. The Alternatives Analysis Reports for OU-2 and OU-3 were submitted to NYSDEC. For OU-2, bench scale studies of stabilization/solidification agents were completed and evaluated for treatment of lead and petroleum impacted soil. In addition, field pilot studies of multiple options to treat petroleum impacted soils were completed and evaluated. Design of a stormwater collection system for portions of OU-2 and OU-3 was completed in 2010 and construction was completed in 2014 under the direction of Ms. Clarke.
- For the same petroleum terminal in Buffalo, New York, the work also included performing activities related to the operation of the remediation systems at the Site. These activities have included preparing a feasibility study work plan for improving water management systems at the site; preparing a work plan, directing the field work and preparing an evaluation summary report for startup and testing of a portion of the groundwater extraction system at the Site; and assisting in preparation of plans to upgrade the existing treatment facilities at the Site.
- For the same petroleum terminal in Buffalo, New York, the work also included preparation of design documents and a completion report for in-place closure of the site's former in-ground oil water separator. In addition, a vapor enhanced extraction pilot study work plan was prepared and implemented at the site for recovery of separate-phase product in one portion of the site located adjacent to the Buffalo River. The results of the VER pilot testing, along with the results of chemical oxidation pilot testing conducted at the site, have been summarized in a Remedial Action Selection report, which recommended implementation of chemical oxidation in this portion of the site. A conceptual plan for implementation of chemical oxidation was submitted with the selection document. The work also included maintaining contact with regulatory agencies regarding the status of activities at the Terminal; preparing compliance monitoring reports for submittal to

the regulatory agencies; overall project coordination; and budget management and tracking.

- Principal Engineer for the investigation, design, and implementation of a soil remediation project at a 4-acre former oil terminal in Cold Spring Harbor, New York under the NYSDEC spills program. The remedy completed included excavation and offsite disposal of approximately 20,000 tons of petroleum contaminated and/or hazardous lead contaminated soil in accordance with the future use of the site under an Environmental Easement. Additional activities completed by Roux at the site included asbestos remediation followed by building demolition, UST removal, and cesspool remediation. Roux prepared a Final Engineering Report, which was accepted by NYSDEC and resulted in the closure of the spill number for the Site.
- Principal Engineer for the investigation, design, and implementation of a soil remediation project at a portion of a former oil terminal in Sag Harbor, New York. The remedy completed included excavation and offsite disposal of approximately 2,000 tons of petroleum contaminated soil from beneath an active public roadway under the NYSDEC spills program. The remedy included extensive traffic control and coordination with Village of Sag Harbor officials, dewatering, water treatment, temporary water discharge of treated water to Sag Harbor and restoration of the public roadway in accordance with the Village of Sag Harbor Department of Public Works requirements. Roux prepared a Final Engineering Report, which was accepted by NYSDEC and resulted in the closure of the spill number for the Site. Project Manager for preparation of a work plan, direction the field activities and preparation of a summary report for investigation of the storm-water collection system at a petroleum terminal in Buffalo, New York. The objectives of the storm sewer investigation were to: prepare a detailed map of the Site's sewer system; re-establish connections that may have become blocked by debris; investigate the structural integrity of the storm sewers; locate areas of groundwater infiltration and assess infiltration rate and quality; assess wet and dry-weather flow and quality; and identify areas contributing surface water to the collection system, including hydrologic modeling using TR-55. Based on the results of the investigation, several improvements to the sewer system were recommended, including eliminating inlets to the system in areas of the site where no active operations currently take place and rehabilitation and/or installation of new sewers to restore flow by gravity to the treatment system.
- Principal Engineer for the investigation, remedial design, construction oversight and operation and maintenance of a bioventing and soil vapor extraction system at the Site of a diesel UST failure in Brooklyn. A free product recovery system was also designed, installed, and operated by Roux. Investigation activities included the use of the sonic drilling technique to advance twelve wells to 85 feet below grade through cobbles and boulders for delineation of separate phase product, soil and groundwater impacts. Eight wells were converted to combination biovent/SVE wells. Design included specification of SVE and biovent blowers, piping, valves, and an automatic control system. Product only pumps were also designed and installed in three wells. Approximately 2,000 gallons of product were recovered to by the two systems and the spill was closed by NYSDEC in 2011.
- Principal Engineer for a Brownfield redevelopment in Staten Island, New York of a former retail service station site under the NYSDEC BCP. There is soil, groundwater and vapor contamination from petroleum-related constituents in the vicinity of the former gasoline piping and pump island (the petroleum source area), as well as historic fill across the entire site. The remedy, described in the Remedial Action Work Plan prepared by Roux, will consist of a sheet pile containment wall around the petroleum source area, a Site Cover System across the entire site, comprised of concrete building slab/walkways, asphalt parking areas and limited landscaped areas and site-wide a sub-slab depressurization system to prevent vapor intrusion into the proposed retail building and offsite migration of impacted soil vapor. A certificate of completion from NYSDEC was obtained in 2020.
- Project Manager for the remedial design at a Superfund Site in Nanuet, New York for the New York State Department of Environmental Conservation. The work included preparation of a preliminary design report, which evaluated two alternatives for handling hazardous soils and sediments at the site contaminated with volatile organic compounds. Each alternative was evaluated on the basis of technical feasibility, cost and schedule for implementation. Based upon this evaluation, off-site disposal was recommended over on-site treatment. The report presented a site-wide conceptual plan for remediation, including soil/sediment excavation, staging and sampling; stream diversion; excavation dewatering; temporary on-site groundwater treatment; and long term monitoring. Duties also included managing and tracking all project budgets and serving as the main client contact.
- Principal Engineer for the design and specification of a large-scale (750 scfm) soil vapor extraction (SVE) pilot system with thermal oxidation off-gas treatment for a client in Brazil. Responsibilities included equipment sizing and specification, selection of materials of construction, SVE well and equipment layout, description of general startup procedures and preparation of a pilot test work plan. The pilot test work plan included a description of the pilot test operating procedures to be followed, operating parameters to be monitored and data to be collected and analyzed. The work also included

conducting the pilot test activities and generating a report that included plans for expanding the SVE system across the Site. The work currently also included technical support for evaluating and optimizing system performance.

- Project Manager for a storm sewer study at the former metals manufacturing facility in Staten Island, New York as part of the Voluntary Cleanup Program for the Site to identify contaminated infiltration sources, provide an accurate site drainage map, and verify contributing areas to each outfall. The investigation included field inspections, surveying, dye testing, and sampling during varying tidal conditions. The storm sewer map prepared was used for future sewer closure and site redevelopment planning.
- Principal engineer for the design of a new storm water collection system for a metals manufacturing site in Staten Island, New York under the NYSDEC VCP. The design included evaluation and hydrologic modeling of the system using the U.S.g Soil Conservation Service TR-55 hydrologic analysis model, inlet structure and pipe sizing and layout, outfall design and specification of materials and methods of construction for all system components.
- Principal-in-Charge of the operation, maintenance, monitoring and reporting activities at multiple active and former petroleum storage and distribution terminals located in New York for a large petroleum company. The work includes operation, maintenance, and performance/compliance monitoring services at the sites that currently have active remediation system installed and monitoring, sampling, and reporting services at sites without systems. The remediation systems include groundwater extraction and treatment, free product recovery, bio-sparging, and soil vapor extraction/air sparging. At these sites, Roux Associates is responsible for: maintaining and troubleshooting the various system components to reduce downtime to the extent possible; repairing and/or replacing equipment as needed; coordinating the upgrading of the electrical systems, as needed, to meet current building code requirements; expanding systems to meet regulatory requirements, as needed; optimizing system performance; collecting performance monitoring samples and data to track the efficiency of the treatment systems; and collecting compliance monitoring data.
- Principal Engineer for at multiple petroleum terminals in New York State for groundwater quality and surface water quality sampling and monitoring well gauging as required by the New York State Department of Environmental Conservation, as well as quarterly reporting for all sites. The work has also included collection of soil quality data at several sites and performance of an electromagnetic survey to support the divestiture and redevelopment of one of these sites. Based on these results, soil removal activities were performed at one of the former terminals in order to obtain regulatory closure of the site. Roux Associates successfully completed the remedial activities to the satisfaction of the regulator and received closure for the client of the open spill number. Regulatory closure of another of these former terminals was obtained based upon the results of ongoing groundwater monitoring and reporting.
- Project Engineer for design of a 2.6-mgd groundwater treatment system at the Fireman's Training Center for Nassau County Department of Public Works on Long Island. The work included design of air strippers, exhaust stacks, liquid-phase GAC treatment units, and all chemical feed and storage facilities, including unit sizing, selection of materials of construction, equipment layout, and coordination with other disciplines. The work also included development of the "mass balance" for the facility.
- Task leader in charge of overseeing a bioventing pilot study conducted by a subconsultant, to treat contaminated vadose zone soils at the Fireman's Training Center site in Nassau County, New York. The work included development of a preliminary design report for the full-scale implementation of bioventing at the site based upon the results of the pilot study.
- Project Engineer for the design, specification, construction and operation of an air sparging and soil vapor extraction pilot at the Long Island terminal of a large petrochemical distributor. The pilot was designed to treat contaminated ground water and vadose zone soils resulting from a one-million-gallon gasoline spill at the site. The work included development of the field sampling program and sampling and evaluation of various parameters to determine the pilot's radius of influence and effectiveness. The work also included performing data analysis and preparation of the pilot study report, which recommended full scale implementation of air sparging at the site. The site-wide implementation of air sparging and expansion of the site's existing vapor extraction system at the same Long Island petrochemical terminal was also part of the work. Responsibilities included design, specification, and layout of all mechanical equipment, vapor extraction, and air sparging wells and new vapor extraction/air sparging piping.
- Task leader responsible for investigating alternatives for the treatment of gasoline contaminated off-gas from air stripping operations a Long Island petrochemical terminal. Based on this evaluation, biofiltration was selected for piloting. Responsibilities included design of a pilot unit; development of sampling and data collection procedures; construction oversight and "troubleshooting" for the unit; coordination of data collection activities; and compilation and analysis of the pilot data.

- Project Engineer for the design of a 0.50-mgd groundwater treatment facility a Long Island petrochemical terminal. Responsibilities included the design, specification, and layout of mechanical equipment, including the air stripping tower, vapor phase granular activated carbon off-gas treatment, centrifugal blowers, ductwork, influent pump, and concrete wet well. Responsible for shop drawing review during the construction phase.
- Project Manager for an investigation at a gasoline service station with soil and groundwater contamination. Responsible for reviewing and evaluating the work of another consultant that performed the soil and groundwater sampling and conducted remedial activities at the site including: investigation summary reports; remedial designs; remediation progress reports; correspondence with regulators; and plans for future work at the Site. The work also included mapping the groundwater flow patterns in the area of the service station and mapping the areal and vertical extent of the groundwater contamination. Responsible for project coordination and budget management and tracking.
- Project Manager for the field investigation, feasibility evaluation, and remedial design at Superfund Site in Spring Valley, New York for the New York State Department of Environmental Conservation. The work included development of a work plan and site operations plan. The field investigations included Geoprobe soil borings; groundwater monitoring well installation; groundwater sampling; aquifer pump testing; and vapor extraction pilot testing. Work also included conducting the field operations for the vapor extraction pilot and producing a summary report of the field investigation results. The report presented an evaluation of the cost and feasibility of several alternatives for remediation of the site. It recommended reducing the level of effort of the remediation presented in the Record of Decision, based on lower levels of contamination encountered during the investigation. Duties also included project coordination; budget management and tracking; and development of subcontract agreements.
- Project Engineer for upgrades to the Spring Creek Auxiliary Water Pollution Control Plant for the City of New York. The work included the evaluation, design, and specification of a two-stage odor control system, chemical storage and feed facilities and new effluent disinfection system.
- Project Engineer responsible for preparation of design documents for the replacement of the sodium hypochlorite pumps and piping at the Mamaroneck Wastewater Treatment Plant for Westchester County Department of Environmental Facilities in New York.
- Project Engineer for design of upgrades to the New Rochelle Wastewater Treatment Facility for Westchester County Department of Environmental Facilities in New York. Designed upgrades to the main influent pump station, including rehabilitation of the existing influent pumps and replacement of the magnetic drives with new variable frequency drives. Responsibilities also included design of a submersible automatic duplex sump pump system, new primary sludge pumps and piping and new primary and secondary settling tank equipment. The work also included assisting the County during the bidding and contractor selection phase and preparing addenda to the contract documents.
- Project Manager for the construction of upgrades to the New Rochelle Wastewater Treatment Facility. Responsibilities included overseeing the shop drawing logging and distribution process; reviewing mechanical equipment shop drawings; addressing contractor questions regarding the contract documents; and coordinating with the resident engineer in the field and the electrical and general contractors.
- Project Engineer for the performance evaluation of the Harriman Wastewater Treatment Plant for the Orange County Department of Environmental Facilities and Services. Responsibilities included documentation of the existing conditions at the plant and evaluation of the historical and current performance of the plant with respect to its potential for expansion. A summary report was prepared, which included evaluations of the existing plant processes with respect to standard design criteria, typical design practices and receiving water considerations. This summary report served as the basis for the facilities plan prepared as the next phase of the project.
- Project Engineer for the facilities plan for the upgrade of the Harriman Wastewater Treatment Plant. Responsibilities included evaluation of alternatives for expanding the plant’s treatment capacity. A report was prepared, which recommended the conversion of the existing oxidation ditches to sequencing batch reactors (SBR) in order to increase the plant’s treatment capacity to 6.0 mgd within the limited space available on the site.
- Project Engineer for the Gates-Chili-Ogden Pump Station and Force main design for Monroe County, New York. The design consisted of a new 36 mgd wet pit/dry pit pump station, influent sewer and force main. Responsibilities included evaluating influent pumping conditions, and design of the influent sewer, manual influent bar racks and a duplex automatic submersible sump pump system for the station.

Brandon D. Vella

Project Scientist

TECHNICAL EXPERIENCE

Phase I and Phase II Environmental Site Assessments (ESAs) conducted in accordance with American Society for Testing and Materials International (ASTM) E1527-13, E2600-15, and E1903-11; management and closure of New York State Department of Environmental Conservation (NYSDEC) spill sites; underground storage tank (UST) investigations and closure; Exposure Assessments (EAs) and Spill Closure Requests; conceptual site model (CSM) development; Environmental Quality Information Systems (EQuIS) database management; Mann-Kendall statistical trend analysis; constituent of concern (COC) migration modeling using Groundwater Spatiotemporal Data Analysis Tool (GWSDAT); investigation and remediation of underground injection control (UIC) structures including stormwater systems, sanitary systems, and grease traps; New York State Pollutant Discharge Elimination System (SPDES) monitoring and Stormwater Pollution Prevention Plan (SWPPP) compliance; installation of soil borings and groundwater monitoring wells; soil vapor intrusion (SVI) investigations; remedial construction oversight; regulatory coordination; development of site-specific health and safety plans (HASPs); Request for Proposal (RFP) development; subcontractor bid evaluation; management of subcontractors and third-party personnel.

EXPERIENCE SUMMARY

Over one year of experience: Project Scientist at Roux Environmental Engineering and Geology, D.P.C., Islandia, New York

Two and a half years of experience: Associate Environmental Scientist and Case Manager at Groundwater & Environmental Services, Inc., Hauppauge, New York

One and a half years of experience: Environmental Scientist at Enviroscience Consultants, Inc., Ronkonkoma, New York

CREDENTIALS

B.S. Biochemistry & Minor Environmental Studies, SUNY Binghamton 2014
OSHA 40-Hour HAZWOPER and 8-Hour Annual Refreshers
OSHA 30-Hour Construction Safety
OSHA Site Supervisor
RCRA and DOT Hazardous Materials Transport
Loss Prevention System (LPS) Manager and Supervisor
ExxonMobil Permit Issuer and Recipient
American Red Cross First Aid and CPR
Smith Safe Driver Trained

PUBLICATIONS

Vella, B.D. & Schertzer, J.W. "Understanding and Exploting Bacterial Outer Membrane Vesicles." *Pseudomonas: Volume 7: New Aspects of Pseudomonas Biology.* Edited by J.-L. Ramos, J.B. Goldberg, & A. Filloux, Dordrecht: Springer Netherlands, 2015, pp. 217-250.

KEY PROJECTS

- Case Manager for a legacy portfolio of active retail gasoline and automotive service stations throughout Nassau, Suffolk, Westchester, and Rockland Counties in New York. The portfolio sites were associated with multiple open NYSDEC spills, numerous historic releases of petroleum product including comingled petroleum hydrocarbon volatile organic compound (VOC) plumes, and multiple historic remediation attempts. Assisted Senior Project Managers by drafting work plans, RFPs, and summary investigation reports. Coordinated and conducted field activities including management and oversight of subcontractor personnel in accordance with site-specific HASPs. Interpreted laboratory analytical data and conducted statistical trend analyses. Drafted technical figures and models such as contour maps, soil data maps, hydrographs, hydrogeologic cross-sections, and soil boring/well logs. Reviewed over three decades worth of historic soil, groundwater, and remediation data in order to refine CSMs. Authored EAs and Spill Closure Requests that were submitted to NYSDEC regulators in support of spill closure.
- Prepared between 50 and 100 Phase I ESAs for properties in the greater New York City and Long Island areas, New Jersey, Connecticut, Rhode Island, Massachusetts, and New Hampshire. These assessments ranged from small residential properties to large scale industrial, commercial, and manufacturing businesses. Responsible for maintaining report integrity and compliance with ASTM E1527-13 and E2600-15 standards. Maintained client expectations and delivered accurate results in a timely manner to satisfy tight due diligence deadlines. Provided recommendations to clients if Phase II ESA investigations were warranted. All Phase I inspections and reports were completed safely, on-time, and within the allotted budgets.
- Case Manager and Field Lead for over one year during the large-scale collection of over 2,000 soil samples from wetland creek areas and adjoining residential properties in order to delineate historic releases of cadmium and hexavalent chromium at a NYSDEC Superfund Site in West Islip, New York. Sample locations were located and logged using global positioning system (GPS) navigation. Provided project quality assurance and quality control (QA/QC) for field activities including management of multiple sampling teams each comprised of three to four samplers. Ensured that all field work adhered to the sampling specifications as directed by the NYSDEC-approved Remedial Investigation Work Plan (RIWP) and Quality Assurance Project Plan (QAPP). Routinely coordinated with both NYSDEC regulators, third-party engineering firm personnel, and residential homeowners in order to achieve sampling objectives.
- Case Manager and Field Lead for light non-aqueous phase liquid (LNAPL) delineation activities at an active retail gasoline and automotive service station in Glen Head, New York, associated with one open NYSDEC spill and multiple historic releases of petroleum product. Coordinated and provided oversight of subcontractor personnel during the advancement of numerous soil borings using sonic drilling technology. Soils were field screened via visual inspection, photoionization detector

(PID) headspace measurements, qualitative fluorescent dye assays, and subsequent subsequently submitted for laboratory analysis of VOCs. Prepared a summary report of the investigative activities that was submitted to NYSDEC and the client. Results of the delineation investigation were used to further refine the CSM in preparation for a remedial engineering alternatives analysis.

- Case Manager and Field Lead for the investigation and remediation of numerous stormwater drywells, sanitary systems, and grease traps for a variety of clients throughout Nassau and Suffolk Counties in Long Island, New York. The impacted underground injection control (UIC) structures, septic tanks, and grease traps were located on properties ranging from small single-family residences to large commercial properties, some of which were historically associated with the use and unauthorized release of hazardous materials and petroleum products. Structures were gauged, measured, and inventoried prior to sampling. Bottom sediment, and standing liquids in some cases, were sampled in accordance with Suffolk County Department of Health Services (SCDHS) Sanitary Code Article XII. Laboratory analytical results were compared to SCDHS Action Levels in order to determine if remediation was warranted. Coordinated remediation strategies under SCDHS oversight which included the removal of liquids and sediment using vacuum trucks, solid and liquid waste disposal, endpoint sampling, and backfilling of the structures with virgin sand. Results of investigative and remediatial activities were reported to clients and SCHDS in order to document proper remediation and/or closure of the structures.

- Case Manager and Field Staff for the installation of remedial system wells at an active retail gasoline and automotive service station in Roslyn, New York. Provided field oversight of subcontractors during well installation activities utilizing sonic drilling technologies in order to upgrade an existing air sparge (AS)/soil vapor extraction (SVE) treatment system targeting residual dissolved-phase and adsorbed-phase hydrocarbons associated with an open NYSDEC petroleum hydrocarbon and methyl-*tertiary*-butyl ether (MTBE) spill.

- Field Staff during Phase I and II ESA divestment activities for a portfolio of various gasoline stations and convenience stores throughout Jefferson County in New York. Conducted site reconnaissance inspections and relayed field findings to office support staff using a mobile reporting platform in order to facilitate expedited reporting requirements. Subsequently oversaw subcontractor personnel during subsurface clearance activities in preparation for the advancement of soil borings and the installation of groundwater monitoring wells. All Phase I and Phase II divestment field activities were completed safely, on-time, and within the allotted budgets.

- Field Lead for one month during stream tributary sediment sampling activities conducted in order to delineate impacts resulting from historic releases of polychlorinated biphenyls (PCBs), VOCs, semi-volatile organic compounds (SVOCs), and heavy metals at a NYSDEC Superfund Site in Dunkirk, New York. Stringent sampling equipment decontamination protocols were adhered to throughout the entire duration of the project. Sample locations with relative measured distances between stream transects, field sketches of wetland terrain, and a comprehensive photographic log were submitted to NYSDEC engineers for review in preparation for land clearing and remedial dredging activities.

- Field Staff during emergency response operations related to a per- and polyfluoroalkyl substances (PFAS) release in New Windsor, New York. Interfaced with Senior Project Managers, airport personnel, NYSDEC regulators, third-party subcontractors, media reporters, and local residents during emergency response operations. Compiled comprehensive photographic and written daily logs over the course of one month documenting the presence and abatement of aqueous film-forming foam (AFFF) found in the on-site network of stormwater drains and off-site stream tributaries throughout the surrounding town. Directed subcontractor personnel to initiate recovery of AFFF using vacuum trucks equipped with skimmers. Monitored stream tributaries for the presence of accumulated AFFF on floating absorbent booms and directed subcontractor personnel to conduct periodic boom change-outs prior to precipitation events. Maintained an inventory of on-site subcontractor resources including the number of vacuum trucks, the number of frac tanks, and accumulated water volume/available capacity of the frac tanks.

- Field Staff for routine wastewater discharge sampling at various industrial sites operated by public transportation agencies and freight carrier corporations throughout the Greater New York City metropolitan area. Collected monthly wastewater samples and recorded influent/effluent flow rates. Conducted monthly site inspections and reported potentially hazardous conditions such as failing safety devices or security controls. Prepared and submitted routine SPDES reports to regulators in accordance with SWPPPs.

- Field Staff for site characterization and remedial excavation activities at an urban housing development in Brooklyn, New York. Delineated zone of hazardous and non-hazardous impacted soils within an area approximately equivalent to one city block. Collected and submitted subsurface soils samples for analysis of VOCs, SVOCs, metals, pesticides, herbicides, and PCBs. Developed the site-specific HASP and oversaw subcontractor personnel including those responsible for operating direct-push drilling equipment, excavators, and ground-penetrating radar.

David E. Kaiser, P.E.

Senior Engineer

TECHNICAL SPECIALTIES

Engineering services including development and review of design drawings, implementation of design, development of technical specifications, review of construction submittals, development of SWPPPs, field management and site safety of various heavy construction projects, and civil/remediation engineering construction management. Designs have included stormwater drainage systems, NYCDEP sewer system, NYCDOB/DOT sidewalk project, and remedial system design. Additional services including budget management, permitting, project coordination, project scheduling, development of bid packages and cost estimating.

Field management and construction oversight of heavy equipment construction including sewer construction, drainage construction, crane lift activities and remedial construction activities. Environmental site assessments focusing on soil, soil vapor, groundwater and excavation dewatering investigations.

EXPERIENCE SUMMARY

Twelve years of experience: Project Engineer with Roux Environmental Engineering & Geology, D.P.C.; Design Engineer with Bohler Engineering.

CREDENTIALS

B.E. Civil Engineering, Hofstra University, 2006
Fundamentals of Engineering E.I.T. Certification, 2006
Professional Engineer (NY), 2017
OSHA 40-Hour HAZWOPER Training, 2008
OSHA 30-Hour Construction Safety Training, 2011
OSHA 10-Hour Construction Safety Training, 2018
OSHA 8-Hour Hazardous Waste Refresher Training, 2017
LPS 8-Hour Training Certification, 2008
First Aid and CPR Certified, 2016
DOT Hazardous Materials Awareness Training, 2017
NYSDEC Erosion and Sediment Control Training, 2016
Transportation Worker Identification Credential (TWIC)

KEY PROJECTS

- Land Development Site Plan Preparation – Design Engineer for the design and development of residential, commercial and industrial site plan packages for Suffolk County, Nassau County and New York City Boroughs. Site plan packages for the various municipalities within Suffolk County, Nassau County and New York City included components such as: zoning analysis, site removals plan, site design and construction documents, water and sewer system design (detention and retention systems), site grading and drainage plans, and lighting analysis and design.
- Suffolk County Drywell Closure – Senior Engineer for the planning and coordination of closing existing drywell structures serving as sanitary and industrial retention basins for an industrial facility. The project consisted of developing a sampling plan for the site, coordinating sampling and inspection of existing sanitary and industrial drywells in accordance with Suffolk County Department of Health Services Article 12, SOP No. 9-95 Pumpout and Soil Cleanup Criteria. Following the sampling event, a summary of results was prepared and sent to the SCDHS for review. Due to exceedances that were present within the septic tanks, a remedial action work plan was developed to identify the required steps for successful closure, which included coordinating the SCDHS field inspection, extraction of contaminated liquids and solids, and proper disposal of the waste.
- Property Drainage System Design and Construction – Project Engineer for the design and development of a new on-site stormwater treatment system located at a former petroleum terminal in Brooklyn, NY. Design included drainage improvements and modifications for the former petroleum terminal to support ongoing remediation activities that were being conducted to facilitate the future closure of an existing in-ground oil/water separator and removal of associated piping, and to support the anticipated long-term remedy for, and potential future redevelopment of the subject property. The proposed drainage modifications included the installation of new drainage structures, Contech treatment structures and conveyance piping to collect and treat stormwater runoff within the property and bypass the existing in-ground oil/water separator, prior to discharging the stormwater via an existing SPDES outfall.
- Oil/Water Separator Closure – Project Engineer for engineering support and review for the closure of an existing in-ground oil/water separator at a former petroleum terminal in Brooklyn, NY. The closure and abandonment of the oil/water separator was deemed the long-term remedy as approved by the NYSDEC. The oil/water separator was originally constructed in the early 1900s and has served the property by providing stormwater runoff treatment. The closure project includes the following tasks: dewatering and treatment of separator water; excavation of existing sludge in separator; dewatering and drying/stabilization of the sludge removed; power washing of interior; backfill and compaction of clean fill inside separator; removal of all existing above-grade structures including catwalks, guardrails, and piping; proper shipping and disposal of sludge contents; installation of a final cover system consisting of a geosynthetic clay liner (GCL) and filter fabric barrier; and final site grading.
- Treatment System Building Upgrades – Project Engineer for the review and implementation of engineering drawings for a metals removal system

upgrade to an existing 450-gpm groundwater treatment system. The upgrades consisted of: relocating and reinstalling the existing oil/water separator tank on a steel spacer via crane; lifting and installing the existing 10,000 gallon equalization tank to be repurposed as a filter backwash solids removal tank; lifting and installing prefabricated concrete pads with a subbase of Geogrid BX1200 and 6" of aggregate size number 57 (as per NYCDDC Highway Specifications and ASTM C33) compacted to 95% Standard Proctor, under proposed tank locations; locating a new 20,000 gallon equalization/aeration tank on the new pad; installing of new blower motor and enclosure; and installing of new piping and appurtenances.

- NYCDEP Private Storm and Sanitary Sewer System – Project/Staff Engineer for the design and development of a New York City Department of Environmental Protection (NYCDEP) Private Storm and Sanitary Sewer System located at a former petroleum terminal in Brooklyn, NY. The sewer system comprised of over 2,600 LF of sewer in Greenpoint, Brooklyn over two phases of construction. During the duration of this project, responsibilities included: develop/revise NYCDEP sewer design plans and construction notes, address NYCDEP comments and markups, develop Bill of Materials, develop cost estimates, develop technical specifications, develop bid package, ensure compliance with NYCDEP and NYCDOT specifications and requirements, develop/revise NYCDOT Builder's Pavement Plan (BPP), develop NYCDOT Maintenance and Protection of Traffic plans, conduct/participate in design construction meetings, review subcontractor submittals and cut sheets, address NYCDEP punch list items, and management/oversight/coordination of subcontractor construction activities.
- NYCDOB/NYCDOT Sidewalk Installation – Project/Staff Engineer for the design, development, and installation of over 4,000 linear feet of new sidewalks over various phases located at a former petroleum terminal in Brooklyn, NY. The design, development, and installation of these sidewalks were in accordance with the New York City Department of Buildings and New York City Department of Transportation specifications and details of construction. During the duration of these projects, my major responsibilities included: develop/revise NYCDOT Builder's Pavement Plans, develop cost estimates, develop technical specifications, develop bid package, ensure compliance with NYCDOB and NYCDOT specifications and requirements, develop NYCDOT Maintenance and Protection of Traffic plans, conduct/participate in design construction meetings, ensure proper installation and testing of sidewalks in accordance with NYCDOB and NYCDOT, and management/oversight/coordination of subcontractor construction activities.
- Sub Slab Depressurization System – Staff Engineer for the design and construction of two sub slab depressurization systems (SSDS) located within the footprint of a petroleum remediation site where a new building was proposed to be built. These projects were part of an Interim Remedial Measure (IRM) Action Plan as approved by the NYSDEC to provide a preventative proactive measure to address potential soil vapor issues. The SSDSs were designed to operate passively; however, header piping was installed to allow for the installation of the necessary equipment if an active system was required. The SSDSs consisted of ¾-inch gravel with 4-inch diameter polyvinyl chloride (PVC) schedule 40 well screen used as soil gas collection piping and 6-inch diameter solid PVC used as the header piping. A vapor barrier/waterproofing membrane and nonwoven geotextile fabric were installed between the venting layer and the floor slab. All penetrations through the floor slab were sealed using a silicone-based waterproof sealant. The scope of work included excavation and trench work for the SSDS; placement of pipe bedding; jointing and installation of the pipe fittings, valves and appurtenances; installation of pipe sleeves and mechanical seals; and installation of nonwoven geotextile fabric and silicone-based waterproof sealant.
- Stormwater Pollution Prevention Plan (SWPPP) Reports – Staff Engineer for preparing and submitting Stormwater Pollution Prevention Plans (SWPPP) for various residential and commercial development sites in New York City and Long Island. The scope of work included preparation of SWPPP Reports in accordance with the most current New York State Department of Environmental Conservation (NYSDEC) regulations at the time, including the 'General Permit for Stormwater Discharges from Construction Activity' and the 'New York State Stormwater Management Design Manual'. Preparation of the SWPPP Reports included: summarizing the site history and project description, soil geology, potential pollutants, erosion and sediment control practices, inspection and maintenance procedures, water quantity and water quality control plans, construction sequence scheduling, and the Notice of Intent (NOI) for each project as required by the NYSDEC.

ROUX

PROFESSIONAL PROFILE

James Hauri, Ph.D.

Senior Scientist

TECHNICAL SPECIALTIES

Dr. Hauri is a broad-based environmental scientist with more than 20 years of experience in environmental science, engineering and chemistry. His multidisciplinary background has included field sampling, environmental analytical chemistry, toxicity testing and data analysis. Much of his work has explored the nexus between the chemistry and ecotoxicity of environmental contaminants.

Dr. Hauri's area of expertise include:

- Heavy metal speciation and toxicology
- Analysis of ecotoxicology data
- Aquatic chemistry and contamination
- Environmental data analysis
- Environmental data validation

EXPERIENCE SUMMARY

Roux Associates, Inc., Senior Scientist (2022 – present)

Assumption University, Associate Professor (tenured), (2007-2012, 2014-2022); Assistant Professor (2001-2007).

Exponent, Senior Scientist (part-time) (2014-2015); (full-time) (2012-2014)

Harvard University, School of Public Health, Visiting Scientist (part time) (2008-2012)

CH2M-Hill, Environmental Consultant (2001)

San Francisco Estuary Institute, Intern, (1997-1998)

Southwest Research Institute, Scientist (1993-1994)

CREDENTIALS

Ph.D., Environmental Engineering, University of California, Berkeley, CA, 2001;

M.S., Environmental Science (concentration in environmental chemistry), Indiana University, Bloomington, IN, 1993;

B.A., Biochemistry, University of Texas, Austin, TX, 1991;

JOURNAL PUBLICATIONS

Knurr, B. and J.F. Hauri. (2020) An Alternative to Recycling: Measurement of Combustion Enthalpies of Plastics via Bomb Calorimetry. Journal of Chemical Education. V.97, pp 1465-1469.

Hauri, J.F., C. Daughton, and R. Klaper. (2016) The Challenge: Establishing Policy in an Uncertain World: What can be done to address emerging environmental contaminants having indeterminate or subtle ecological or human impacts? Environmental Toxicology and Chemistry. V.35(2), pp. 266-270.

Niece, B. and J.F. Hauri. (2013) Determination of Mercury in Fish: A Low-Cost Implementation of Cold-Vapor Atomic Absorbance for the Undergraduate Environmental Chemistry Laboratory. Journal of Chemical Education. V.90 (14), pp 487–489

Hauri, J. and B. Niece. (2011) Leaching of silver from silver-impregnated food containers. Journal of Chemical Education. V.88 (10), pp 1407–1409

Hauri, J.F. and L.A. Schaider. (2009) Remediation of Acid Mine Drainage with Sulfate Reducing Bacteria. Journal of Chemical Education. v. 86 (2), pp. 216-218. Hauri, J.F. and A.J. Horne. (2006) Copper toxicity reduction via EDTA addition: a real world application. Water Environment Research. v. 78, pp. 2508-2513.

Hauri, J.F. and A.J. Horne. (2004) Reduction in Labile Copper in the 7 Day Ceriodaphnia dubia Toxicity Test due to the interaction with zooplankton food. Chemosphere. v. 56, pp. 717-723.

OTHER PUBLICATIONS

Lincoln, R., C. Amarasiriwardena, J. Shine, A. Ettinger, C. Paciorek, J. Hauri, R. Wright, J. Spengler (2011) Meconium as a biomarker for prenatal metals exposure: Methodological considerations and variations in serial samples over time (Diss. Chapter). Biomarkers of Metals Exposure in Two High-Risk Communities. School of Public Health, Harvard University.

Hauri, J.F. (1998) Scoping study of air deposition monitoring information relevant to water quality of San Francisco Bay, Final Report. Bay Area Stormwater Management Agencies Association.

Hauri, J.F., and Alex J. Horne. (1997) Bioavailability and toxicity of heavy metals in urban runoff in simulated natural conditions. University of California Water Resources Center

SELECTED CONFERENCE PRESENTATIONS

Knurr, B. and J. Hauri (2021) Connecting Bomb Calorimetry to Environmental Issues: Two Bomb Calorimetry Experiments. Presented at the Fall ACS National Meeting, August 22-26. Atlanta, GA.

Drumm, E., and J. Hauri (2020) Analysis of Existing Water Quality Datasets of Lake Quinsigamond, Massachusetts. Poster accepted at North Atlantic Regional Chapter of the Society of Environmental Toxicology and Chemistry Meeting, April 13-14, Avery Point, CT. Accepted, but conference was cancelled.

Hauri, J. and B. Niece. (2018) Fingerprinting White Wines with Excitation-Emission Matrix

Fluorescence. Poster presented at the Fall ACS National Meeting, August 19-23. Boston, MA.

Hauri, J. (2017) Variation to the Excitation-Emission Matrix Fluorescence Characterization of Allochthonous Dissolved Organic Carbon due to pH changes. Poster presented 38th Annual Society of Environmental Toxicology and Chemistry National Meeting, 12 - 16 November, Minneapolis, MN.

S. Kane Driscoll, J. Hauri, K. Kulacki, A. M. Morrison, M. McArdle, A.Schierz, K. Yozzo, and M. Edwards. (2016) The Influence of Mixing Energy on the Concentration and Composition of Oil in Laboratory Toxicity Tests. Poster presented 37th Annual Society of Environmental Toxicology and Chemistry National Meeting, 6 - 10 November, Orlando, FL.

Yozzo, K. S. Kane Driscoll, J. Hauri, M. McArdle, and A.M. Morrison. (2016) Review of Current Literature of Cardiotoxicity of Oil to Early Life Stages of Fish and the Use in Injury Assessments. Presentation at 37th Annual Society of Environmental Toxicology and Chemistry National Meeting, 6 - 10 November, Orlando, FL.

Kane Driscoll, S., R. Wells Whittlesey, J. Hauri, K. Kulacki, A. Schierz, T.L. Morse, A.M. Morrison, and K. Yozzo. (2016) The Influence of Mixing energy on the Concentration, Composition, Toxicity, and Relevance of the Laboratory Toxicity Tests. Poster presented at the Gulf of Mexico Oil Spill and Ecosystem Science Conference. 1-4 February, Tampa Bay, Fl.

J. Hauri and K. Wirzbicki. (2011) Excitation-Emission Matrix Fluorescence Characterization of Dissolved Organic Carbon Leached from Leaves from Various Tree Species. Poster presented at the Society of Environmental Toxicology and Chemistry National Meeting, 13 - 17 November, Boston, MA.

Frazier, K., K. Cushing, and J. Hauri (2010) A visual documentation of acute toxicity in zooplankton. Poster presented at the North Atlantic Regional Chapter of the Society of Environmental Toxicology and Chemistry Meeting, June 2-4, Narragansett, RI.

Hauri, J. (2007) Adapting research for laboratory experiments in undergraduate environmental chemistry courses. Presented at the 234th ACS National Meeting, August 19-23, Boston, MA.

Kulevich, S. J. Van Doren, and J. Hauri. (2006) Green arsenic remediation. Presented at the 231st ACS National Meeting, March 26-30, Atlanta, GA.

Hauri, J. and B. Niece. (2005) Removal of Ibuprofen through a Wastewater Treatment Plant. Poster presented Society of Environmental Toxicology and Chemistry National Meeting, 14 - 17 November, Baltimore, MD.

Miller, M. and J.F. Hauri. (2005) Development of an HPLC/UV Method for the Detection of Ibuprofen in River Water. Poster presented at the National Conference on Undergraduate Research, April 21-23, Lexington, VA.

Parnass, K. and J.F. Hauri. (2004) Development of an HPLC/UV Method for the Measurement of Environmentally Relevant Concentrations of Ibuprofen. Poster presented at the North Atlantic Regional Chapter of the Society of Environmental Toxicology and Chemistry Meeting, June 9-11, Portsmouth, RI.

Hauri, J.F. and A.J. Horne. (2002) Copper toxicity reduction via EDTA addition: a real world application. Presentation at the Society of Environmental Toxicology and Chemistry National Meeting, 16 - 20 November, Salt Lake City, UT.

Hauri, J.F. and A.J. Horne. (2002) Copper toxicity reduction via EDTA addition: a real world application. Poster presented at the American Chemical Society National Meeting, 18-22 August, Boston, MA.

Hauri, J.F., P. Frank, and A.J. Horne. (1999) Acid mine drainage in rural and urban environments. Presented before the 19th NALMS Annual Meeting, 1-4 December, Reno, Nevada.

Hauri, J.F., K.D. Zoh, A. Steding, and A.J. Horne. (1999) Trinitrotoluene toxicity reduction to Ceriodaphnia dubia by humic acid complexation. Poster presented at the 19th NALMS Annual Meeting, 1-4 December, Reno, Nevada.

Hauri, J.F., and A.J. Horne. (1997) Toxicity and chemistry of copper in urban runoff from San Francisco Bay creeks. Presented before the CALMS Annual Meeting, November, California.

Hauri, J.F., and A.J. Horne. (1997) Influence of food on bioavailability of copper in the 7-day Ceriodaphnia dubia bioassay. Poster presented at the 18th SETAC Annual Meeting, 16-27 November, San Francisco, California.

Hauri, J.F., and A.J. Horne. (1997) Toxicity and chemistry of copper in urban runoff from San Francisco Bay creeks. Presented before the 17th NALMS Annual Meeting, 2-6 December, Houston, Texas

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

American Chemistry Society (ACS)

Society of Environmental Toxicology and Chemistry (SETAC)

NAC SETAC – board of directors 2005-2008, VP 2008-2009, Pres 2009-2010

ATTACHMENT 2

Standard Operating Procedures, Laboratory Detection Limits for Emerging Contaminants and NYSDEC Guidance for Sampling Emerging Contaminants

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

November 2022

www.dec.ny.gov

Table of Contents

November 2022

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
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
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

Citation and Page Number	Current Text	Corrected Text	Date
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
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	

November 2022

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC’s Part 375 Remedial Programs

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]

---

[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 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.

Water Sample Results

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.

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

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:

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]	1.1	3.7

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

---

[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 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).

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 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.

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

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

1. Project and Site Name.

2. DEC Region.

3. All personnel (and affiliation) involved in the collection.

4. Method of collection (gill net, hook and line, etc.)

5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

3. Date collected.

4. Sample location (waterway and nearest prominent identifiable landmark).

5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **<u>The Bureau of Ecosystem Health will supply the bags.</u>** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **The Bureau of Ecosystem Health will supply the larger bags.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

No materials containing Teflon.
No Post-it notes.
No ice packs; only water ice or dry ice.
Any gloves worn must be powder free nitrile.
No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
Wear clothing washed at least six times since purchase.
Wear clothing washed without fabric softener.
Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

page ______ of ______

Project and Site Name ______________________________________ DEC Region ______________

Collections made by (include all crew) ______________________________________

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ____________________

Preservation Method: ☐Freezing ☐Other ____________________ Notes (SWFDB survey number): ____________________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ____________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ___________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of _____________________________________, in _______________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on __________________________________, 20______.

____ ____________________________
Signature Date

I, ________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) _______________________________________ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

____________________________________ __________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

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.

Method 1633 Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS

References: Method 1633 - Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS (2nd Draft - June 2022)

DOD QSM (US Department of Defense Quality Systems Manual for Environmental Laboratories, version 5.4, 20221)

1. Scope and Application

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

Definitions: Refer to Alpha Analytical Quality Manual.

1.1 Method 1633 is for use in the Clean Water Act (CWA) for the determination of the per- and polyfluoroalkyl substances (PFAS) in Table 1 in aqueous, solid (soil, biosolids, sediment) and tissue samples by liquid chromatography/mass spectrometry (LC-MS/MS).

1.2 The method calibrates and quantifies PFAS analytes using isotopically labeled standards. Where linear and branched isomers are present in the sample and either qualitative or quantitative standards containing branched and linear isomers are commercially available, the PFAS analyte is reported as a single analyte consisting of the sum of the linear and branched isomer concentrations

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

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

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

2. Summary of Method

2.1 Environmental samples are prepared and extracted using method-specific procedures. Sample extracts are subjected to cleanup procedures designed to remove interferences. Analyses of the sample extracts are conducted by LC-MS/MS in the multiple reaction monitoring (MRM) mode. Sample concentrations are determined by isotope dilution or extracted internal standard quantification using isotopically labeled compounds added to the samples before extraction.

2.2 Aqueous samples are spiked with isotopically labeled standards, extracted using solid-phase extraction (SPE) cartridges and undergo cleanup using carbon before analysis.

2.3 Solid samples are spiked with isotopically labeled standards, extracted into basic methanol, and cleaned up by carbon and SPE cartridges before analysis

2.4 Tissue samples are spiked with isotopically labeled standards, extracted in potassium hydroxide and acetonitrile followed by basic methanol, and cleaned up by carbon and SPE cartridges before analysis.

2.5 A sample extract is injected into an LC equipped with a C18 column that is interfaced to an MS/MS). The analytes are separated and identified by comparing the acquired mass spectra and retention times to reference spectra and retention times for calibration standards acquired under identical LC/MS/MS conditions. The concentration of each analyte is determined by using the isotope dilution technique. Extracted Internal Standards (EIS) analytes are used to monitor the extraction efficiency of the method analytes.

2.6 Method Modifications from Reference

N/A

3. Reporting Limits

The reporting limit for PFAS's are listed in Table 8.

4. Interferences

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

4.2 Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The method analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc. All items such as these must be routinely demonstrated to be free from interferences (less than 1/2 the RL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks as described in Section 9.1. Subtracting blank values from sample results is not permitted.

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

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

5. Health and Safety

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

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

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

6. Sample Collection, Preservation, Shipping and Handling

6.1 Sample Collection for Aqueous Samples

6.1.1 Samples must be collected in two (2) 500-mL or 250-mL high density polyethylene (HDPE) container with an unlined plastic screw cap. All sample containers must have linerless HDPE or polypropylene caps.

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

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

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

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

6.1.6 Maintain all aqueous samples protected from light at 0 - 6 °C from the time of collection until shipped to the laboratory. Samples must be shipped as soon as practical with sufficient ice to maintain the sample temperature below 6 °C during transport and be received by the laboratory within 48 hours of collection. The laboratory must confirm that the sample temperature is 0 - 6 °C upon receipt. Once received by the laboratory, the samples must be stored at ≤ -20 °C until sample preparation.

6.2 Sample Collection for Soil and Sediment samples.

6.2.1 Grab samples are collected in polypropylene containers. Sample containers and contact surfaces containing PTFE shall be avoided. Samples should fill no more than ¾ full.

6.2.2 Maintain solid samples protected from light (in HDPE containers) at 0 - 6 ºC from the time of collection until receipt at the laboratory. The laboratory must confirm that the sample temperature is 0 - 6 ºC upon receipt. Once received by the laboratory, the samples must be stored at ≤ -20 ºC until sample preparation.

6.3 Sample Collection for fish and other tissue samples

6.3.1 Once received by the laboratory, the samples must be maintained protected from light at ≤ -20 ºC until prepared. Store unused samples in HDPE containers or wrapped in aluminum foil at ≤ -20 ºC.

6.3.2 The nature of the tissues of interest may vary by project. Field sampling plans and protocols should explicitly state the samples to be collected and if any processing will be conducted in the field (e.g., filleting of whole fish or removal of organs). All field procedures must involve materials and equipment that have been shown to be free of PFAS.

6.4 Sample Preservation

Not applicable.

6.5 Sample Shipping

Samples must be chilled during shipment and must not exceed 0 – 6 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 0 – 6 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction but should not be frozen.

NOTE: Samples that are significantly above 0 – 6 ° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

6.6 Sample Handling

6.6.1 Aqueous samples (including leachates) should be analyzed as soon as possible; however, samples may be held in the laboratory for up to 90 days from collection, when stored at ≤ -20 ºC and protected from the light. When stored at 0 - 6 ºC and protected from the light, aqueous samples may be held for up to 28 days, with the caveat that issues were observed with certain perfluorooctane sulfonamide ethanols and perfluorooctane sulfonamidoacetic acids after 7 days. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.

6.6.2 Solid samples (soils and sediments) and tissue samples may be held for up to 90 days, if stored by the laboratory in the dark at either 0 - 6 ºC or ≤ -20 ºC, with the caveat that samples may need to be extracted as soon as possible if NFDHA is an important analyte.

6.6.3 Biosolids samples may be held for up to 90 days, if stored by the laboratory in the dark at 0 - 6 °C or at -20 °C. Because microbiological activity in biosolids samples at 0 - 6 °C may lead to production of gases which may cause the sample to be expelled from the container when it is opened, as well as producing noxious odors, EPA recommends that samples be frozen if they need to be stored for more than a few days before extraction. Store sample extracts in the dark at less than 0 - 4 °C until analyzed. If stored in the dark at less than 0 - 4 °C, sample extracts may be stored for up to 90 days, with the caveat that issues were observed for some ether sulfonates after 28 days. These issues may elevate the observed concentrations of the ether sulfonates in the extract over time. Samples may need to be extracted as soon as possible if NFDHA is an important analyte.

7. Equipment and Supplies

7.1 SAMPLE CONTAINERS – 500-mL or 250-mL high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.

7.2 SAMPLE JARS – 8-ounce wide mouth high density polyethylene (HDPE) bottles fitted with unlined screw caps. Sample bottles must be discarded after use.

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

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

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

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

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

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

7.8 PLASTIC PIPETS – Polypropylene or polyethylene disposable pipets.

7.9 Silanized glass wool (Sigma-Aldrich, Cat # 20411 or equivalent) – store in a clean glass jar and rinsed with methanol (2 times) prior to use.

7.10 Disposable syringe filter, 25-mm, 0.2-µm Nylon membrane, PALL/Acrodisc or equivalent

7.11 Variable volume pipettes with disposable HDPE or polypropylene tips (10 µL to 5 mL) used for preparation of calibration standards and spiked samples.

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

7.13 ANALYTICAL BALANCE – Capable of weighing to the nearest 0.1 g.

7.14 SOLID PHASE EXTRACTION (SPE) APPARATUS FOR USING CARTRIDGES

7.14.1 SPE CARTRIDGES – (Waters Oasis WAX 150 mg, Cat # 186002493 or equivalent). The SPE sorbent must have a pKa above 8 so that it remains positively charged during the extraction.

7.14.1.1 Note: SPE cartridges with different bed volume (e.g., 500 mg) may be used; however, the laboratory must demonstrate that the bed volume does not negatively affect analyte absorption and elution, by performing the initial demonstration of capability analyses described in Section.

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

7.14.3 SAMPLE DELIVERY SYSTEM – Use of a polypropylene transfer tube system, which transfers the sample directly from the sample container to the SPE cartridge, is recommended, but not mandatory. Standard extraction manifolds come equipped with PTFE transfer tube systems. These can be replaced with 1/8” O.D. x 1/16” I.D. polypropylene or polyethylene tubing cut to an appropriate length to ensure no sample contamination from the sample transfer lines. Other types of non-PTFE tubing may be used provided it meets the MB and LCS QC requirements.

7.15 EXTRACT CONCENTRATION SYSTEM – Extracts are concentrated by evaporation with nitrogen using a water bath set no higher than 55 °C.

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

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

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

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

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

7.17.4 INSTRUMENT COLUMNS

7.17.4.1 ANALYTICAL: C18 column, 1.7 µm, 50 x 2.1 mm (Waters Acquity UPLC® BEH or equivalent)

7.17.4.2 OPTIONAL GUARD COLUMN: (Phenomenex Kinetex® Evo C18 or equivalent)

8. Reagents and Standards

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

8.1.1 REAGENT WATER – Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/2 the RL for each method analyte of interest. Prior to daily use, at least 3 L of reagent water should be flushed from the purification system to rinse out any build-up of analytes in the system's tubing.

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

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

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

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

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

8.1.7 ACETONITRILE – UPLC grade or equivalent, store at room temperature

8.1.8 TOLUENE – HPLC grade or equivalent.

8.1.9 ACETONE – pesticide grade or equivalent

8.1.10 AMMONIUM ACETATE – (Caledon Ultra LC/MS grade or equivalent

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

8.1.12 METHANOLIC AMMONIUM HYDROXIDE (0.3%) - add ammonium hydroxide (1 mL, 30%) to methanol (99 mL), store at room temperature, replace after 1 month

8.1.13 METHANOLIC AMMONIUM HYDROXIDE (1%) - add ammonium hydroxide (3.3 mL, 30%) to methanol (97 mL), store at room temperature, replace after 1 month

8.1.14 METHANOLIC AMMONIUM HYDROXIDE (2%) - add ammonium hydroxide (6.6 mL, 30%) to methanol (93.4 mL), store at room temperature, replace after 1 month

8.1.15 METHANOLIC POTASSIUM HYDROXIDE (0.05 M) – add 3.3 g of potassium hydroxide to 1 L of methanol, store at room temperature, replace after 3 months

8.1.16 METHANOL WITH 4% WATER, 1% AMMONIUM HYDROXIDE AND 0.625% ACETIC ACID - add ammonium hydroxide (3.3 mL, 30%), reagent water (1.7 mL) and acetic acid (0.625 mL) to methanol (92 mL), store at room temperature, replace after 1 month. This solution is used to prepare the instrument blank and calibration standards (Section 8.3.2).

8.1.17 FORMIC ACID – (greater than 96% purity or equivalent).

8.1.18 FORMIC ACID (aqueous, 0.1 M) - dissolve formic acid (4.6 g) in reagent water (1 L), store at room temperature, replace after 2 years

8.1.19 FORMIC ACID (aqueous, 0.3 M) - dissolve formic acid (13.8 g) in reagent water (1 L), store at room temperature, replace after 2 years

8.1.20 FORMIC ACID (aqueous, 5% v/v) - mix 5 mL formic acid with 95 mL reagent water, store at room temperature, replace after 2 years

8.1.21 FORMIC ACID (methanolic 1:1, 0.1 M formic acid/methanol) - mix equal volumes of methanol and 0.1 M formic acid, store at room temperature, replace after 2 years

8.1.22 FORMIC ACID (aqueous, 50% v/v) - mix 50 mL formic acid with 50 mL reagent water, store at room temperature, replace after 2 years

8.1.23 POTASSIUM HYDROXIDE – certified ACS or equivalent

8.1.24 CARBON - – EnviCarb® 1-M-USP or equivalent, verified by lot number before use, store at room temperature. Loose carbon allows for better adsorption of interferent organics. Note: The single-laboratory validation laboratory achieved better performance with loose carbon than carbon cartridges. Loose carbon will be used for the multi-laboratory validation to set statistically based method criteria.

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

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

8.2 REFERENCE MATRICES - Matrices in which PFAS and interfering compounds are not detected by this method. These matrices are to be used to prepare the batch QC samples.

8.2.1 Reagent water - purified water, Type I

8.2.2 Solid reference matrix Ottawa Sand or equivalent

8.2.3 Tissue Reference matrix – Cod loin or other animal tissue demonstrated to be PFAS free

8.3 STANDARD SOLUTIONS – When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. PFAS analyte and IS standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers and are stored at ≤4 °C. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples.

8.3.1 Stock standards and diluted stock standards are stored at ≤4 °C. Prepare a spiking solution, containing the method analytes listed in Table 1, in methanol from prime stocks. The solution is used to prepare the calibration standards and to spike the known reference QC samples that are analyzed with every batch. Quantitative standards containing a mixture of branched and linear isomers must be used for method analytes if they are commercially available. Currently, these include PFOS, PFHxS, NEtFOSAA, and NMeFOSAA.

8.3.2 Calibration standard solutions – A series of calibration solutions containing the target analytes and the Labeled extracted internal standards (EIS) and non-extracted internal standards (NIS) is used to establish the initial calibration of the analytical instrument. Table 4 represents the concentrations of the native, EIS and NIS analytes of the calibration curve. Calibration standard solutions are made using the solution described in section 8.1.16.

8.3.3 ISOTOPE DILUTION EXTRACTED INTERNAL STANDARD (EIS) – Isotopically labelled analogs of the target analytes to be used for the quantification of target analytes. EIS stock standard solutions are purchased in glass ampoules and are stored in accordance with the manufacturer's recommendations. The EIS stock solution to be used for the fortification of samples and QC in accordance with the isotope dilution procedure. Table 2 represents the EIS concentrations and nominal sample amounts added to each field sample and QC element.

8.3.4 ISOTOPE DILUTION NON-EXTRACTED INTERNAL STANDARDS (NIS) – Isotopically labelled analogs to be added post extraction for the measurement of EIS extraction efficiency and is added to the final volume of all extractions. Table 3 represents the EIS concentrations and nominal sample amounts added to each field sample and QC element.

9. Quality Control

9.1 Method Blank

9.1.1 A Method Blank (MB) is required with each extraction batch to confirm that potential background contaminants are not interfering with the identification or quantitation of method analytes. An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents and standards. Prep and analyze a MB for every 20 samples. If the MB produces a peak within the retention time window of any analyte that would prevent the determination of that analyte, determine the source of contamination, and eliminate the interference before processing samples. Background contamination must be reduced to an acceptable level before proceeding. Background from method analytes or other contaminants that interfere with the measurement of method analytes must be below the RL. If the method analytes are detected in the MB at concentrations equal to or greater than this level, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.

9.2 Laboratory Control Sample (LCS)

9.2.1 Low Level LCS or OPR (Ongoing Precision Recovery) sample is required with each extraction batch. A LLCS or OPR samples is a method blank spiked with known quantities of analytes. The fortified concentration of the LCS is spiked at 2X the LOQ. Default limits of 70-130% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation:

9.2.2 An LCS or OPR (Ongoing Precision Recovery) sample is required with each extraction batch. A LCS or OPR samples is a method blank spiked with known quantities of analytes. The fortified concentration of the LCS is spiked at the midpoint of the calibration curve. Default limits of 70-130% of the true value may be used for analytes until sufficient replicates have been analyzed to generate proper control limits. Calculate the percent recovery (%*R*) for each analyte using the equation:

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

Where:

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

9.1.1 Where applicable, in the absence of additional sample volume required to perform matrix specific QC, LCSD's are to be extracted and analyzed. The concentration and analyte recovery criteria for the LCSD must be the same as the batch LCS The RSD's must fall within ≤30% of the true value for medium and high-level replicates, and ≤50% for low level replicates. Calculate the relative percent difference (RPD) for duplicate MSs (MS and MSD) using the equation:

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

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

9.3 Non-extracted Internal Standard Area (NIS)

Each time an initial calibration is performed, use the data from all the initial calibration standards used to meet the linearity test in Section 10.3.3.3 to calculate the mean area response for each of the NIS compounds, using the equation below.

$$\text{Mean Area}_{\text{NISi}} = \sum \text{AREA}_{\text{NISi}} / \text{n}$$

where:

AreaNISi = Area counts for the ith NIS, where i ranges from 1 to 7, for the seven NIS compounds listed in Table 1

n = The number of ICAL standards (the default value is n = 6). If a different number of standards is used for the ICAL, for example, to increase the calibration range or by dropping a point at either end of the range to meet the linearity criterion, change 6 to match the actual number of standards used)

Record the mean areas for each NIS for use in evaluating results for sample analyses. There is no acceptance criterion associated with the mean NIS area data.

9.4 Extracted Internal Standards (EIS)

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

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

Where:

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

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

9.5 Matrix Spike (MS/MSD)

9.5.1 Analysis of an MS is prepared one per preparation batch (if required).

9.5.2 Aliquots of field samples that have been fortified with a known concentration of target compounds, prior to sample preparation and extraction, and analyzed to measure the effect of matrix interferences. The use of MS/MSD samples is generally not required in isotope dilution methods because the labeled compounds added to every sample provide more performance data than spiking a single sample in each preparation batch. Aliquots of field samples

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

9.6 Laboratory Duplicate

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

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

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

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

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

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

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

9.7 Bile Salt Interference Check

9.7.1 The laboratory must analyze a TDCA standard after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from TDCA (e.g., changing the retention time of TDCA such that it falls outside the

9.8 Initial Calibration Verification (ICV)

9.8.1 After each ICAL, analyze a QCS sample from a source different from the source of the CAL standards. If a second vendor is not available, then a different lot of the standard should be used. The QCS should be prepared and analyzed just like a CCV. Acceptance criteria for the QCS are identical to the CCVs; the calculated amount for each analyte must be ± 30% of the expected value. If measured analyte concentrations are not of acceptable accuracy, check the entire analytical procedure to locate and correct the problem.

9.9 Instrument Sensitivity Check (ISC)

9.9.1 At the start of each 12-hour shift, analyze a standard at the LOQ. The signal-to-noise ratio of the ISC standard must be greater than or equal to 3:1. If the requirements cannot be met, the problem must be corrected before analyses can proceed

9.10 Continuing Calibration Verification (CCV)

9.10.1 CCV Standards must be analyzed at the beginning of each analysis batch, after every 10 Field Samples, and at the end of the analysis batch.

9.10.2 The recovery of native and isotopically labeled compounds for the CVs must be within 70 - 130%

9.10.3

9.11 Method-specific Quality Control Samples

9.11.1 Instrument Blank – During the analysis of a batch of samples, a solvent blank is analyzed after samples containing high level of target compounds (e.g., calibration, CV) to monitor carryover from the previous injection. The injection blank consists of the solution in

Section 8.1.16 fortified with the EIS and NIS for quantitation purposes.

9.12 Example Method Sequence

- INSTRUMENT BLANK
- INSTRUMENT SENSITIVITY CHECK
- CALIBRATION VERIFICATION STANDARD
- QUALITATIVE IDENTIFICATION STANDARDS
- TDCA STANDARD (only if analyzing tissues)
- INSTRUMENT BLANK
- METHOD BLANK
- LOW-LEVEL LCS/OPR
- OPR/LCS
- SAMPLE (10 or fewer)
- CALIBRATION VERIFICATION STANDARD
- INSTRUMENT BLANK
- SAMPLE (10 or fewer)
- CALIBRATION VERIFICATION STANDARD
- INSTRUMENT BLANK

10. Procedure

10.1 Equipment Set-up

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

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

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

10.1.4 All SPE apparatus, including manifolds, tubing and sample ports must be thoroughly rinsed following each use with 1% methanolic ammonium hydroxide, followed by Methanol and then DI water. Additionally, sample manifold ports and transfer tubing should be inspected regularly for signs of wear and/or discoloration. When such observations are made, the associated components should be replaced.

10.1.5 Prior to the start of any extraction, sample site information must be evaluated for any potentially high level PFAS concentrations or sample matrix irregularities that may impact the extraction process. If such samples are identified, aqueous samples may be pre-screened via direct aqueous injection prior to analysis to estimate the potential PFAS concentrations present.

10.1.6 To perform a direct aqueous injection (DAI) screen, the sample should be inverted several times to try and evenly disperse any organic matter present. A 1 ml aliquot (or less depending on the matrix) is to be taken from the parent sample, volume adjusted to 1 ml with reagent water if less than 1ml, fortified with EIS and NIS spiking solutions to match the concentrations of an extracted sample (typically 5 µl per 1 ml DAI), and then analyzed under the same analytical conditions as field samples.

10.2 Sample Preparation of Aqueous Samples

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

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

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

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

10.2.4 Check that the pH is 6.5 ± 0.5. If necessary, adjust pH with 50% formic acid or ammonium hydroxide and 3% aqueous ammonium hydroxide. The extract is now ready for solid-phase extraction (SPE) and cleanup.

10.2.5 Add 20 µL of the EIS to each sample and QC, cap and invert to mix.

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

10.3 Sample Prep and Extraction Protocol for Soils, Solids and Sediments.

10.3.1 Homogenize and weigh 5 grams of sample (measured to the nearest hundredth of a gram) into a 50 ml polypropylene centrifuge tube. For laboratory control blanks and spikes, 5 grams of clean sand is used.

10.3.1.1 For Biosolids and other complex matrices, a small aliquot may be required due to co-extracted matrix interferences.

10.3.1.2 For batch QC samples using 5 g of reference solid, add 2.5 g of reagent water. The addition of reagent water to the sand provides a matrix closer in composition to real-world samples.

10.3.2 Add 20 µL of the EIS to each sample and QC.

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

10.3.4 Vortex the samples to evenly disperse the spiking solutions and allow to equilibrate for 30 minutes.

10.3.5 To all samples, add 10 ml of 0.3% methanolic ammonium hydroxide, cap, vortex for 25 seconds.

10.3.6 Following mixing, shake each sample for 30 minutes on a shaker table.

10.3.7 Centrifuge each sample at 2800RPM for 10 minutes.

10.3.8 Remove the supernatant and transfer to a clean 50 ml polypropylene centrifuge tube.

10.3.9 Repeat steps 10.3.4 to 10.3.7, with 15 ml of 0.3% methanolic ammonium hydroxide, combining the supernatants.

10.3.10 Add 5ml of 0.3% methanolic ammonium hydroxide to the sample, vortex for 25 seconds and centrifuge each sample at 2800RPM for 10 minutes.

10.3.11 Remove the supernatant and transfer to the same 50 ml polypropylene centrifuge tube containing eluates from the previous cycles.

10.3.12 Add 10 mg of carbon to the combined extract, mix by occasional hand shaking for no more than five minutes and then centrifuge at 2800 rpm for 10 minutes. Immediately decant the extract into a 50 ml polypropylene centrifuge tube.

10.3.13 Dilute to approximately 35 mL with reagent water. Samples containing more than 50% water may yield extracts that are greater than 35 mL in volume; therefore, do not add water to these. Determine the water content in the sample as follows (percent moisture is determined from the % solids):

Water Content in Sample = (Sample Weight * Percent moisture) / 100

10.3.14 Concentrate each extract at approximately 55 °C with a gentle N2 flow to a final volume that is based on the water content of the sample (see table below). Allow extracts to concentrate for 10 minutes, then mix (by vortex if the volume is < 20. Continue concentrating and mixing every 5 minutes until the extract has been reduced to the required volume as specified in the table below. If the extract volume appears to stop dropping, the concentration must be stopped and the volume at which it was stopped recorded.

Water Content in Sample	Concentrated Final Volume
< 5 grams	15 ml
5-8 grams	15-20 ml
8-9 grams	20-22.5 ml
9-10 grams	22.5-25 ml

10.3.15 Add 40 - 50 mL of reagent water to the extract and vortex. Check that the pH is 6.5 ±0.5 and adjust as necessary with 50% formic acid or 30% ammonium hydroxide, or with 5% formic acid and 3% aqueous ammonium hydroxide. The extracts are ready for SPE and cleanup.

10.4 Sample Prep and Extraction Protocol for Tissues.

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

10.4.2 Add 20 µL of the EIS PDS to each sample and QC.

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

10.4.4 Add 10 mL of 0.05M KOH in methanol to each sample. Vortex to disperse the tissue then place tubes on a mixing table to extract for at 16 hours. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant in a 50-mL polypropylene centrifuge tube.

10.4.5 Add 10 mL of acetonitrile to remaining tissue in the 50-mL centrifuge tube, vortex to mix and disperse the tissue. Sonicate for 30 minutes. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant, adding it to the 50-mL centrifuge tube containing the initial extract.

10.4.6 Add 5 mL of 0.05M KOH in methanol to the remaining sample in each centrifuge tube. Vortex to disperse the tissue and hand mix briefly. Centrifuge at 2800 rpm for 10 minutes and collect the supernatant, adding it to the 50-mL centrifuge tube containing the first two extracts.

10.4.7 Add 10 mg of carbon to the combined extract, mix by occasional hand shaking over a period of no more than five minutes and then centrifuge at 2800 rpm for 10 minutes. Immediately decant the extract into a 50-mL centrifuge tube.

10.4.8 Add 1 mL of reagent water to each tube and concentrate each extract at approximately 55 °C with a gentle N2 flow to a final volume of 2.5 ml.

10.4.9 Add reagent water to each evaporation/concentrator tube to dilute the extracts to 50 mL. Check that the pH = 6.5 ± 0.5 and adjust as needed with 50% formic acid, or ammonium hydroxide or with 5% formic acid and 3% aqueous ammonium hydroxide. The extracts are ready for SPE and cleanup.

10.5 SPE Extract: All matrices

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

10.5.2 Pre-condition the cartridges by washing them with 3 X 5 mL of 1% methanolic ammonium hydroxide, discarding the wash volumes.

10.5.3 Rinse the cartridge with 5 mL of 0.3M formic acid, allowing the cartridge to drain using gravity only, discarding the rinse volume. Do not allow the cartridge to go dry

10.5.4 Adjust the vacuum so that the approximate flow rate is ~5 mL/min and load the sample across the cartridge. Do not allow the cartridge to go dry before all the sample has passed through.

10.5.5 Once all the sample has passed across the cartridge, rinse the walls of the reservoir with 2 X 5 mL reagent water, loading the rinse across the cartridge.

10.5.6 Rinse the walls of the reservoir with 5 mL of 1:1 0.1M formic acid/methanol and pass the rinse through the cartridge using vacuum. Dry the cartridge by pulling air through for 15 seconds.

10.5.7 Rinse the inside of the sample bottle with 5 mL of 1% methanolic ammonium hydroxide. Use vacuum to pull the elution solvent through the cartridge and into the collection tubes. When the cartridge bed and glass wool are submerged, stop the cartridge flow by closing the valve, keeping the sorbent bed and wool submerged.

10.5.8 Let the wetted sorbent bed and wool soak for 1 minute.

10.5.9 Open the cartridge valve and collect the eluate into a 15 ml polypropylene collection tube.

10.5.10 Add 25 µL of concentrated acetic acid to each sample eluted in the collection tubes and vortex to mix.

10.5.11 Add 10 mg of carbon to each sample and batch QC extract, using a 10-mg scoop. Handshake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon. Immediately vortex (30 seconds) and centrifuge at 2800 rpm for 10 minutes.

10.5.12 Add NIS solution to a clean collection tube. Place a syringe filter (25-mm filter, 0.2-µm nylon membrane) on a 5-mL polypropylene syringe. Take the plunger out and carefully decant the sample supernatant into the syringe barrel. Replace the plunger and filter the entire extract into the new collection tube containing the NIS.

10.5.13 Vortex to mix and transfer a portion of the extract into a .7-mL polypropylene LC vial for LC-MS/MS analysis. Cap the collection tube containing the remaining extract and store at 4 °C

10.6 Sample Volume Determination

10.6.1 If using weight to determine volume, weigh the empty bottle to the nearest 1 g and determine the sample weight by subtraction of the empty bottle weight from the original sample weight. Assume a sample density of 1.0 g/mL. In either case, the sample volume will be used in the final calculations of the analyte concentration.

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

10.7.1 ESI-MS/MS TUNE

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

10.7.1.2 Optimize the [M-H]- or [M-CO_2]- for each method analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (0.4 mL/min). This tune can be done on a mix of the method analytes. The MS parameters (voltages, temperatures, gas flows, etc.) are varied until optimal analyte responses are determined.

The method analytes may have different optima requiring some compromise between the optima.

The Mass spec conditions found in Table 7 show the Sciex Triple Quad 5500+ operation conditions used in this method.

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

The conditions found on table 5 are representative of expected tune optimizations for each analyte. If conditions other the ones close to the values provided in table 5 are achieved, the process should be re-performed and/or instrument maintenance performed to resolve the problem.

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

Table 6 represents the operation conditions of a Sciex Exion LC system when running this method.

10.7.3 Inject 2µl of a mid-level CAL standard under LC/MS conditions to obtain the retention times of each method analyte. Divide the chromatogram into retention time windows each of which contains one or more chromatographic peaks. During MS/MS analysis, fragment a small number of selected precursor ions ([M-H]-) for the analytes in each window and choose the most abundant product ion. For maximum sensitivity, small mass windows of ±0.5 daltons around the product ion mass were used for quantitation.

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

NOTE: PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 7 due to chromatographic resolution of the linear and branched isomers of these compounds. Most PFAS's are produced by two different processes. One process gives rise to linear PFAS's only while the other process produces both linear and branched isomers. Thus, both branched and linear PFAS's can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all the chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in a sample must be integrated in the same way as the CAL standard.

10.7.5 Prepare a set of CAL standards as outlined in table 5. The lowest concentration CAL standard must be at or below the LOQ.

10.7.6 The LC/MS/MS system is calibrated using the isotope dilution technique. Target analytes are quantitated against their isotopically labeled analog (Extracted Internal Standard) where commercially available. If a labeled analog is not commercially available, the extracted internal standard with the closest retention time and /or closest chemical similarity is to be used. Use the LC/MS/MS data system software to generate a linear regression or quadratic calibration curve for each of the analytes. This curve must always be forced through zero and may be concentration weighted, if necessary. Forcing zero allows for a better estimate of the background levels of method analytes. A minimum of 5 levels are required for a linear calibration model and a minimum of 6 levels are required for a quadratic calibration model.

10.7.7 CALIBRATION ACCEPTANCE CRITERIA – A linear fit is acceptable if the calculated RSD or RSE for each target analyte is ≤20%. If linear or Quadratic regressions are used, coefficient of determination (r^2) values must be greater than 0.99. When quantitated using the initial calibration curve, each calibration point at or above the LOQ for each analyte must calculate to be within 70-130% of its true value. The calculate value of each EIS analyte must be within 50-150% of its true value. If these criteria cannot be met, corrective action is taken to reanalyze the CAL standards, restrict the range of calibration.

10.7.8 Bile salts interference check - The laboratory must analyze a TDCA standard after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from TDCA (e.g., changing the retention time of TDCA such that it falls outside the retention window for PFOS by at least one minute), and the initial calibration repeated.

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

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

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

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

10.9 EXTRACT ANALYSIS

10.9.1 The same operating conditions used for the initial calibration and summarized in Tables 6 and 7 are to be used.

10.9.2 Prior to analysis of sample extracts, the Instrument mass calibration verification must be performed using standards whose mass range brackets the masses of interest and performed in the negative ion mode. The mass calibration is verified if the calculated mass is within ± .2 daltons of the specified mass.

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

10.9.4 Calibrate the system by either the analysis of a calibration curve or by confirming the initial calibration is still valid by analyzing a CCV.

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

10.9.6 For concentrations at or above the method LOQ, the total (branched and linear isomer) quantification ion response to the total (branched and linear isomer) confirmation ion response ratio must fall within ± 50% of the ratio observed in the midpoint initial calibration standard.

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

10.9.8 The analyst must not extrapolate beyond the established calibration range. If an analyte peak area exceeds the range of the initial calibration curve, the sample should be re-extracted with a reduced sample volume in order to bring the out of range target analytes into the calibration range. If a smaller sample size would not be representative of the entire sample, the following options are recommended. Re-extract an additional aliquot of sufficient size to ensure that it is representative of the entire sample. Spike it with a higher concentration of internal standard. Prior to LC/MS analysis, dilute the sample so that it has a concentration of internal standard equivalent to that present in the calibration standard. Then, analyze the diluted extract.3

10.9.9 In instances where re-extraction is not an option, dilute a subsample of the sample extract with 0.1% acetic acid by a factor no greater than 10x adjust the amount of the NIS in the diluted extract, and analyze the diluted extract. If the responses for each EIS in the diluted extract meet the S/N and retention time, and the EIS recoveries from the analysis of the diluted extract are greater than 5%, then the compounds associated with those EISs may be quantified using isotope dilution. Use the EIS recoveries from the original analysis to select the dilution factor, with the objective of keeping the EIS recoveries in the dilution above that 5% lower limit. If the adjusted EIS recoveries are below 5%, the dilution is assumed invalid. If the adjusted EIS recoveries are greater than 5%, adjust the compound concentrations, detection limits, and minimum levels to account for the dilution.

11. Data Evaluation, Calculations and Reporting

11.1 Complete chromatographic resolution is not necessary for accurate and precise measurements of analyte concentrations using MS/MS. In validating this method, concentrations were calculated by measuring the product ions listed in Table 9.

11.2 Calculate analyte concentrations using the multipoint calibration established in Section 10.9. Do not use daily calibration verification data to quantitate analytes in samples. Adjust final analyte concentrations to reflect the actual sample volume determined in Section 10.8

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

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

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

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

11.4 PFHxS, PFOS, PFOA, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 7 due to the linear and branch isomers of these compounds (Sect. 10.10.4.). The areas of all the linear and branched isomer peaks observed in the CAL standards for each of these analytes must be summed and the concentrations reported as a total for each of these analytes.

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

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

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

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

13. Method Performance

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

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

13.2 Demonstration of Capability Studies

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

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

14. Pollution Prevention and Waste Management

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

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

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

15. Referenced Documents

Chemical Hygiene Plan – ID 2124

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

SOP ID 1739 Demonstration of Capability (DOC) Generation SOP

SOP ID 1728 Hazardous Waste Management and Disposal SOP

16. Attachments

Table 1: Names, Abbreviations, and CAS Registry Numbers for Target PFAS, Extracted Internal Standards and Non-extracted Internal Standards

Parameter	Acronym	CAS
PER- and POLYFLUOROALKYLETHER CARBOXYLIC ACIDS (PFECAs)		
Tetrafluoro-2-(heptafluoropropoxy)propanoic 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
PERFLUOROALKYLCARBOXILIC ACIDS (PFCAs)		

Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluoorotetradecanoic acid	PFTeDA	376-06-7
PERFLUOROALKYL SULFONIC ACIDS (PFASs)		
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	68259-12-1

Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluorododecanesulfonic acid	PFDoS	79780-39-5
CHLORO-PERFLUOROALKYLSULFONATE		
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
FLUOROTELOMER CARBOXYLIC ACIDS		
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	914637-49-3
Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4
PERFLUOROOCTANESULFONAMIDES		
Perfluorooctanesulfonamide	PFOSA	754-91-6
N-methylperfluoro-1-octanesulfonamide	NMeFOSA	31506-32-8
N-ethylperfluoro-1-octanesulfonamide	NEtFOSA	4151-50-2
PERFLUOROCTANE SULFONAMIDE ETHANOLS		
N-Methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2
TELOMER SULFONIC ACIDS		

1H,1H,2H,2H-perfluorohexanesulfonic acid (4:2)	4:2FTS	757124-72-4
1H,1H,2H,2H-perfluorooctanesulfonic acid (6:2)	6:2FTS	27619-97-2
1H,1H,2H,2H-perfluorodecanesulfonic acid (8:2)	8:2FTS	39108-34-4
PERFLUOROOCTANESULFONAMIDOACETIC ACIDS		
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
PERFLUOROETHER AND POLYETHER CARBOXYLIC ACIDS		
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6

Table 2: Stock and Nominal Extracted Internal Standard Concentrations

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M4PFBA	2000	40
M5PFPeA	1000	20
M5PFHxA	500	10
M4PFHpA	500	10
M8PFOA	500	10
M9PFNA	250	5
M6PFDA	250	5
M7PFUdA	250	5
MPFDoA	250	5
M2PFTeDA	250	5
M3PFBS	466	9.32
M3PFHxS	474	9.48
M8PFOS	479	9.58
M2-4:2FTS	938	18.8

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M2-6:2FTS	951	19
M2-8:2FTS	960	19.2
M8FOSA	500	10
d3-N-MeFOSA	500	10
d5-N-EtFOSA	500	10
d3-N-MeFOSAA	1000	20
d5-N-EtFOSAA	1000	20
d7-N-MeFOSE	5000	100
d9-N-EtFOSE	5000	100
M3HFPO-DA	2000	40

Table 3: Stock and Nominal Non-Extracted Internal Standard Concentrations

Isotope Labeled Standard	Conc. of EIS Stock (ng/mL)	Nominal amount of EIS added to extracts (ng)
M3PFBA	1000	40
M2PFHxA	500	10
M4PFOA	500	10
M5PFNA	250	5
M2PFDA	250	5
18O2PFHxS	474	9.48
M4PFOS	479	9.58

Table 4: Initial Calibration levels and Concentrations

Analyte	Cal A	Cal B (LOQ)	CAL C	Cal D	Cal E (CCV)	Cal F	Cal G	Cal H	Cal I
PFBA	.4	.8	2	5	10	20	50	250	500
PFPeA	.2	.4	1	2.5	5	10	25	125	250
PFHxA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFHpA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFOA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFNA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFDA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFUnA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFDoA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFTrDA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFTA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
PFBS	0.089	0.177	0.444	1.11	2.22	4.44	11.1	55.4	111
PFPeS	0.094	0.188	0.471	1.18	2.35	4.71	11.8	58.8	118

PFHxS	0.091	0.183	0.457	1.14	2.29	4.57	11.4	57.1	114
PFHpS	0.095	0.191	0.477	1.19	2.38	4.77	11.9	59.6	119
PFOS	0.093	0.186	0.464	1.16	2.32	4.64	11.6	58	116
PFNS	0.096	0.192	0.481	1.20	2.41	4.81	12	60.1	120
PFDS	0.097	0.193	0.483	1.21	2.41	4.83	12.1	60.3	121
PFDOS	0.097	0.194	0.485	1.21	2.43	4.85	12.1	60.6	121.
4:2FTS	0.375	0.75	1.88	4.69	9.38	18.8	46.9	234	469
6:2FTS	0.38	0.76	1.9	4.75	9.5	19	47.5	238	475
8:2FTS	0.384	0.768	1.92	4.8	9.6	19.2	48	240	480
PFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NEtFOSA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSAA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NEtFOSAA	.1	.2	.5	1.25	2.5	5	12.5	62.5	125
NMeFOSE	1	2	5	12.5	25	50	125	625	1250
NEtFOSE	1	2	5	12.5	25	50	125	625	1250
HFPO-DA	.4	.8	2	5	10	20	50	250	500
ADONA	0.378	0.756	1.89	4.73	9.45	18.9	47.3	236	473
9Cl-PFONS	0.374	0.748	1.87	4.68	9.35	18.7	46.8	234	468
11Cl-PFOUdS	0.378	0.756	1.89	4.73	9.45	18.9	47.3	236	473
PFMPA	.2	.4	1	2.5	5	10	25	125	250
PFMBA	.2	.4	1	2.5	5	10	25	125	250
PFEESA	0.178	0.356	0.89	2.23	4.45	8.9	22.3	111	223
NFDHA	.2	.4	1	2.5	5	10	25	125	250
3:3FTCA	.5	1	2.5	6.25	12.5	25	62.5	312	624
5:3FTCA	2.5	5	12.5	31.3	62.5	125	312	1560	3120
7:3FTCA	2.5	5	12.5	31.3	62.5	125	312	1560	3125
M4PFBA	10	10	10	10	10	10	10	10	10
M5PFPeA	5	5	5	5	5	5	5	5	5
M5PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M4PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M8PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M9PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M6PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M7PFUdA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
MPFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25

M2PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M3PFBS	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33	2.33
M3PFHxS	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
M8PFOS	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
M2-4:2FTS	4.69	4.69	4.69	4.69	4.69	4.69	4.69	4.69	4.69
M2-6:2FTS	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76
M2-8:2FTS	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
M8FOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-N-MeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d5-N-EtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-N-MeFOSAA	5	5	5	5	5	5	5	5	5
d5-N-EtFOSAA	5	5	5	5	5	5	5	5	5
d7-N-MeFOSE	25	25	25	25	25	25	25	25	25
d9-N-EtFOSE	25	25	25	25	25	25	25	25	25
M3HFPO-DA	10	10	10	10	10	10	10	10	10
M3PFBA	5	5	5	5	5	5	5	5	5
M2PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M4PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
M5PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
M2PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2PFHxS	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
M4PFOS	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4

Table 5: Expected Mass Transitions and instrument conditions.

Q1	Q2	Analyte	DP Volts	CE Volts
213.032	169.022	PFBA	-50	-14
263.039	219.03	PFPeA	-55	-12
263.039	68.9	PFPeA_2	-55	-55
313.047	269.037	PFHxA	-45	-12
313.047	119	PFHxA_2	-45	-28
363.055	319.045	PFHpA	-60	-12
363.055	169.022	PFHpA_2	-60	-24
413.063	369.053	PFOA	-65	-14
413.063	169.022	PFOA_2	-65	-23
463.071	419.061	PFNA	-70	-14
463.071	219.03	PFNA_2	-70	-24

513.078	469.069	PFDA	-80	-16
513.078	219.03	PFDA_2	-80	-30
563.086	519.076	PFUnA	-85	-18
563.086	269.037	PFUnA_2	-85	-25
613.094	569.084	PFDoA	-85	-18
613.094	319.045	PFDoA_2	-85	-28
663.102	619.092	PFTrDA	-85	-20
663.102	169.022	PFTrDA_2	-85	-36
713.11	669.1	PFTA	-70	-22
713.11	169.022	PFTA_2	-70	-38
299.092	80.062	PFBS	-100	-65
299.092	99.061	PFBS_2	-100	-40
349.1	80.062	PFPeS	-100	-75
349.1	99.061	PFPeS_2	-100	-60
399.107	80.062	PFHxS	-120	-75
399.107	99.061	PFHxS_2	-120	-80
449.115	80.062	PFHpS	-140	-95
449.115	99.061	PFHpS_2	-140	-80
499.113	80.062	PFOS	-145	-108
499.113	99.061	PFOS_2	-145	-85
549.131	80.062	PFNS	-180	-100
549.131	99.061	PFNS_2	-180	-100
599.139	80.062	PFDS	-170	-110
599.138	99.061	PFDS_2	-170	-100
699.154	80.062	PFDoS	-160	-150
699.154	99.061	PFDoS_2	-160	-130
327.146	307.139	4:2FTS	-100	-28
327.146	81.07	4:2FTS_2	-100	-50
427.161	407.155	6:2FTS	-120	-33
427.161	81.07	6:2FTS_2	-120	-65
527.177	507.17	8:2FTS	-140	-39
527.177	81.07	8:2FTS_2	-140	-85
498.146	78.07	FOSA	-150	-90
498.146	478	FOSA_2	-150	-35
512.163	219.03	NMeFOSA	-130	-35
512.163	169.022	NMeFOSA_2	-130	-40
526.192	219.03	NEtFOSA	-140	-35
526.192	169.022	NEtFOSA_2	-140	-35
570.202	419.061	NMeFOSAA	-100	-28

570.202	483	NMeFOSAA_2	-100	-22
584.229	419.061	NEtFOSAA	-100	-28
584.229	526.192	NEtFOSAA_2	-100	-38
616.1	58.9	NMeFOSE	-90	-70
630	58.9	NEtFOSE	-80	-75
285.035	169.022	HFPO-DA	-60	-12
285.035	184.9	HFPO-DA_2	-60	-18
377.06	251.028	ADONA	-65	-18
377.06	84.8	ADONA_2	-65	-48
530.8	351.05	9Cl-PFONS	-130	-38
532.8	353	9Cl-PFONS_2	-130	-38
630.9	451.031	11Cl-PFOUdS	-145	-41
632.9	452.9	11Cl-PFOUdS_2	-145	-41
241.085	177.069	3:3FTCA	-60	-12
241.085	117	3:3FTCA_2	-60	-50
341.101	237.072	5:3FTCA	-70	-20
341.101	217	5:3FTCA_2	-70	-35
441.117	316.9	7:3FTCA	-85	-30
441.117	337.088	7:3FTCA_2	-85	-20
315.093	135.013	PFEESA	-100	-35
315.093	82.9	PFEESA_2	-100	-25
229.032	85.006	PFMPA	-40	-25
279.042	85.006	PFMBA	-45	-25
295.032	201	NFDHA	-30	-15
295.032	84.9	NFDHA_2	-30	-40
217.001	171.999	MPFBA	-50	-14
268.001	222.999	M5PFPeA	-55	-12
318.009	273.007	M5PFHxA	-45	-12
367.024	322.022	M4PFHpA	-60	-12
421.002	376	M8PFOA	-65	-14
472.002	427	M9PFNA	-70	-14
519.033	474.03	M6PFDA	-80	-16
570.033	525.031	M7-PFUdA	-85	-18
615.079	570.033	MPFDoA	-85	-18
715.094	670.092	M2PFTeDA	-70	-22
302.069	80.062	M3PFBS	-100	-65
402.084	80.062	M3PFHxS	-120	-74
507.062	80.062	M8PFOS	-145	-85
329.13	81.07	M2-4:2FTS	-100	-50

429.162	81.07	M2-6:2FTS	-120	-65
529.162	81.07	M2-8:2FTS	-140	-85
506.077	78.07	M8FOSA	-150	-90
515.183	219.03	d3-NMeFOSA	-130	-35
531.222	219.03	d5-NEtFOSA	-140	-35
573.22	419.061	d3-NMeFOSAA	-75	-28
589.259	419.061	d5-NEtFOSAA	-90	-28
623.2	58.9	d7-NMeFOSE	-100	-28
639.2	58.9	d9-NEtFOSE	-100	-28
287.02	169.022	M3HFPO-DA	-60	-12
216.009	171.999	M3PFBA	-50	-14
315.032	270.03	M2PFHxA	-45	-12
417.032	372.03	M4PFOA	-65	-14
468.032	423.03	M5PFNA	-70	-14
515.063	470.061	M2PFDA	-80	-16
403.107	84.062	18O2-PFHxS	-120	-74
503.093	80.062	M4PFOS	-145	-85

Table 6: LC Method Conditions

Time (min)	2 mM Ammonium Acetate (5:95 CH/H_2O)	100% Acetonitrile	Gradient Curve
Initial	100.0	0.0	0
.2	100.0	0.0	2
4	70	30	7
7	45	55	8
9	25	80	8
10	5	95	6
10.4	98	2	10
11.8	100	0	7
12	100	0	1
Waters Aquity UPLC ® BEHC$_{18}$ 2.1 x 50 mm packed with 1.7 µm BEH C$_{18}$ stationary phase Flow rate of 0.4 mL/min 2 µL injection			

Table 7: ESI-MS Method Conditions

ESI Conditions	
Polarity	Negative ion
Curtain Gas	30
Collision gas	9
Ion Spray Voltage	-4500
Desolvation gas temp.	500 °C
Ion Source Gas 1	30
Ion Source Gas 2	50
Entrance Poitential	-10
Exic Cell Potential	-11

Table 8. Reporting limits by Matrix

Compound	**Aqueous (ng/L)**	**Solid (ng/g)**	**Tissue (ng/g)**
PFBA	6.4	0.8	2
PFPeA	3.2	0.4	1
PFHxA	1.6	0.2	0.5
PFHpA	1.6	0.2	0.5
PFOA	1.6	0.2	0.5
PFNA	1.6	0.2	0.5
PFDA	1.6	0.2	0.5
PFUnA	1.6	0.2	0.5
PFDoA	1.6	0.2	0.5
PFTrDA	1.6	0.2	0.5
PFTA	1.6	0.2	0.5
PFBS	1.6	0.2	0.5
PFPeS	1.6	0.2	0.5
PFHxS	1.6	0.2	0.5
PFHpS	1.6	0.2	0.5
PFOS	1.6	0.2	0.5
PFNS	1.6	0.2	0.5
PFDS	1.6	0.2	0.5
PFDoS	1.6	0.2	0.5
4:2FTS	6.4	0.8	2
6:2FTS	6.4	0.8	2
8:2FTS	6.4	0.8	2
FOSA	1.6	0.2	2
NMeFOSA	1.6	0.2	0.5

NEtFOSA	1.6	0.2	0.5
NMeFOSAA	1.6	0.2	0.5
NEtFOSAA	1.6	0.2	0.5
NMeFOSE	16	2	5
NEtFOSE	16	2	5
HFPO-DA	6.4	0.8	2
ADONA	6.4	0.8	2
9Cl-PFONS	6.4	0.8	2
11Cl-PFOUdS	6.4	0.8	2
3:3FTCA	8	1	2.5
5:3FTCA	40	5	12.5
7:3FTCA	40	5	12.5
PFEESA	3.2	0.4	1
PFMPA	3.2	0.4	1
PFMBA	3.2	0.4	1
NFDHA	3.2	0.4	1

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 Ziploc® 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). 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).

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 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 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

STANDARD OPERATING PROCEDURE 4.4 FOR SAMPLING GROUND-WATER MONITORING WELLS FOR DISSOLVED CONSTITUENTS

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 an 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

APPENDIX G

Site Management Forms

ROUX ENVIRONMENTAL ENGINEERING AND GEOLOGY D.P.C.

SITE-WIDE MONITORING, INSPECTION, AND MAINTENANCE FORM

Client: **Sendero Verde Redevelopment Project - Parcel A**
Location: **50 East 112th Street, New York, New York**
BCP Site # **C231135**
Inspector:
Date:

Site Observations:

Yes	No	
[ ]	[ ]	Have any site improvements been made since the last inspection?
[ ]	[ ]	Has there been any maintenance activity impacting the institutional and/or engineering controls?
		-Include sketches or photos of observations

Inspection of Building Covers and Asphalt/Concrete Caps:

Yes	No	
[ ]	[ ]	Were all buildings inspected?
[ ]	[ ]	Were significant cracks observed?
[ ]	[ ]	Was any other damage observed? If yes, refer to Page 3 for additional clarification.
[ ]	[ ]	Were any new slab penetrations observed? If yes, include description on Page 3.
		-Include sketches or photos of observations

Inspection of Groundwater Usage:

Yes	No	
[ ]	[ ]	Is groundwater underlying the property being used for any purposes including, but not limited to, drinking water or industrial purposes?

Include additional information and details on Page 3 of this inspection form if the response to any of the above questions warrants additional explanation.

ROUX ENVIRONMENTAL ENGINEERING AND GEOLOGY D.P.C.

SITE-WIDE MONITORING, INSPECTION, AND MAINTENANCE FORM

Client: **Sendero Verde Redevelopment Project - Parcel A**
Location: **50 East 112th Street, New York, New York**
BCP Site # **C231135**
Inspector: ____________________
Date: ____________________

Inspection of Remaining Contaminated Material:

Yes	No	
[ ]	[ ]	Have there been any activities that caused a disturbance of remaining contaminated material since the last inspection?
[ ]	[ ]	If yes, were the activities conducted in accordance with the Site Management Plan (SMP)? -Include sketches or photos of observations

Inspection of Gardens and Farming:

Yes	No	
[ ]	[ ]	Is there any evidence of vegetable gardens and/or farming at the property (aside from raised planters)? -Include sketched or photos of observations.

Site Records:

Yes	No	
[ ]	[ ]	Are site records up to date (e.g., Site Inspection Checklists)?

Inspection of Property Usage:

Yes	No	
[ ]	[ ]	Is the property being used for any purposed other than restricted residential, commercial, and/or industrial use?

Include additional information and details on Page 3 of this inspection form if the response to any of the above questions warrants additional explanation.

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

SITE-WIDE MONITORING, INSPECTION, AND MAINTENANCE FORM

Client: **Sendero Verde Redevelopment Project - Parcel A**

Location: **50 East 112th Street, New York, New York**

BCP Site # **C231135**

Inspector:

Date:

Site Observations

Additional Comments or Clarification Where Corrective Actions May Be Required:

APPENDIX H

Responsibilities of Owner and Remedial Party

APPENDIX H- RESPONSIBILITIES of OWNER and REMEDIAL PARTY RESPONSIBILITIES

The responsibilities for implementing the Site Management Plan ("SMP") for the Sendero Verde Redevelopment Project- Parcel A site (the "site"), number C231135, are divided between the site owner(s) and a Remedial Party, as defined below. The owner(s) is/are currently listed as:

- Legal Owner - Acacia Sendero Verde Housing Development Fund Company, Inc.
- Beneficial Owner - SV-A Moderate Owners LLC

Solely for the purposes of this document and based upon the facts related to a particular site and the remedial program being carried out, the term Remedial Party ("RP") refers to any of the following: certificate of completion holder, volunteer, applicant, responsible party, and, in the event the New York State Department of Environmental Conservation ("NYSDEC") is carrying out remediation or site management, the NYSDEC and/or an agent acting on its behalf. The RP is:

SV-A Owners LLC, 551 Fifth Avenue, 23rd Floor, New York, NY, att. Ms. Sabrina Barker

Nothing on this page shall supersede the provisions of an Environmental Easement, Consent Order, Consent Decree, agreement, or other legally binding document that affects rights and obligations relating to the site.

<u>Site Owner's Responsibilities:</u>

1) The owner shall follow the provisions of the SMP as they relate to future construction and excavation at the site.
2) In accordance with a periodic time frame determined by the NYSDEC, the owner shall periodically certify, in writing, that all Institutional Controls set forth in a(n) Environmental Easement remain in place and continue to be complied with. The owner shall provide a written certification to the RP, upon the RP's request, in order to allow the RP to include the certification in the site's Periodic Review Report (PRR) certification to the NYSDEC.
3) In the event the site is delisted, the owner remains bound by the Environmental Easement and shall submit, upon request by the NYSDEC, a written certification that the Environmental Easement is still in place and has been complied with.
4) The owner shall grant access to the site to the RP and the NYSDEC and its agents for the purposes of performing activities required under the SMP and assuring compliance with the SMP.
5) The owner is responsible for assuring the security of the remedial components located on its property to the best of its ability. In the event that damage to the remedial components or vandalism is evident, the owner shall notify the site's RP and the NYSDEC in accordance with the timeframes indicated in Section D-1: Notifications.
6) In the event some action or inaction by the owner adversely impacts the site, the owner must notify the site's RP and the NYSDEC in accordance with the time frame indicated in Section D-1: Notifications and (ii) coordinate the performance of necessary corrective actions with the RP.
7) The owner must notify the RP and the NYSDEC of any change in ownership of the site property (identifying the tax map numbers in any correspondence) and provide contact

information for the new owner of the site property. 6 NYCRR Part contains notification requirements applicable to any construction or activity changes and changes in ownership. Among the notification requirements is the following: Sixty days prior written notification must be made to the NYSDEC. Notification is to be submitted to the NYSDEC Division of Environmental Remediation's Site Control Section. Notification requirements for a change in use are detailed in Section 2.4 of the SMP. A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html.

8) The owner will maintain fences, conduct mowing, etc. on behalf of the RP. The RP remains ultimately responsible for maintaining the engineering controls.

Remedial Party Responsibilities

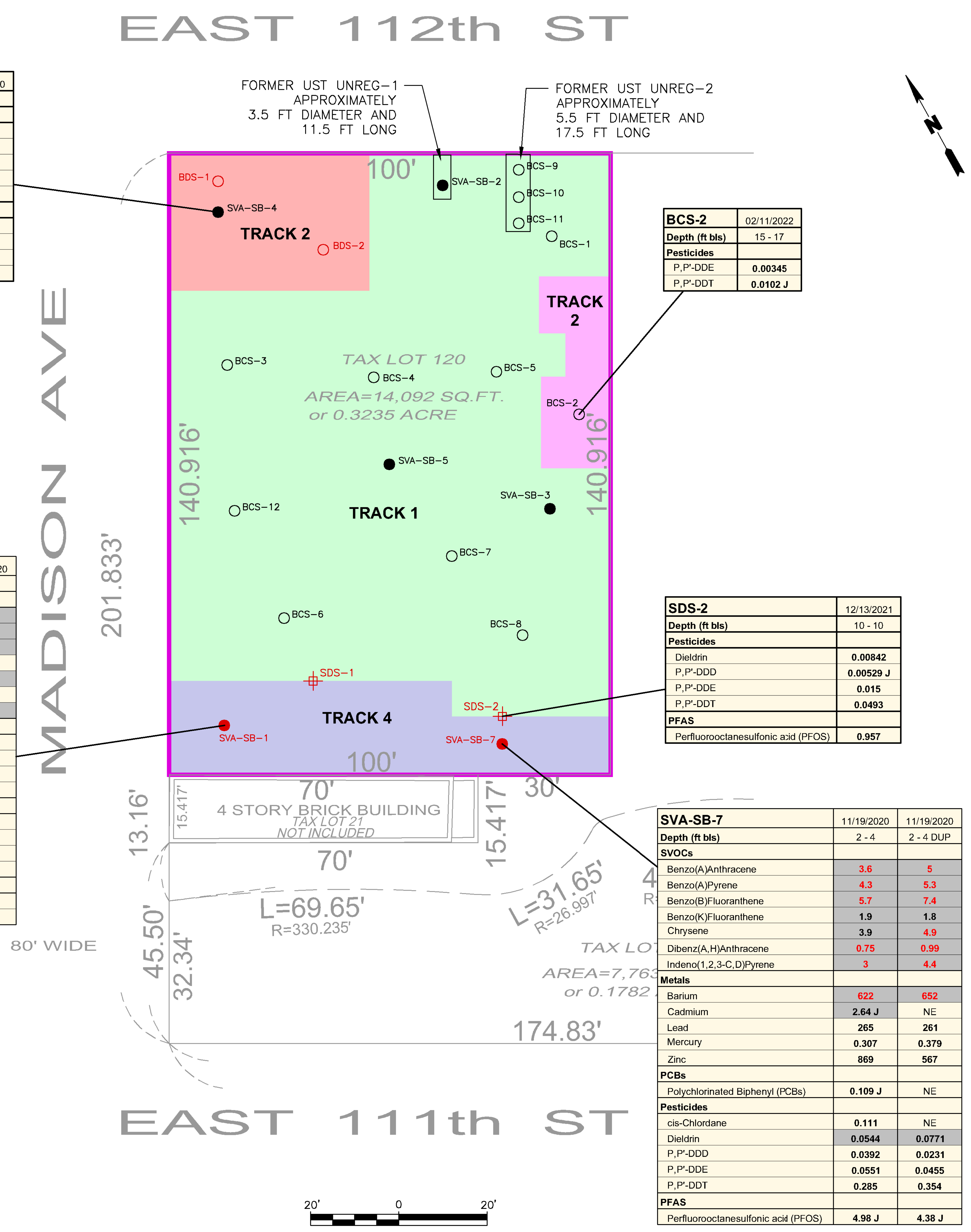
1) The RP must follow the SMP provisions regarding any construction and/or excavation it undertakes at the site.
2) The RP shall report to the NYSDEC all activities required for remediation, operation, maintenance, monitoring, and reporting. Such reporting includes, but is not limited to, periodic review reports and certifications, electronic data deliverables, corrective action work plans and reports, and updated SMPs.
3) Before accessing the site property to undertake a specific activity, the RP shall provide the owner advance notification that shall include an explanation of the work expected to be completed. The RP shall provide to (i) the owner, upon the owner's request, (ii) the NYSDEC, and (iii) other entities, if required by the SMP, a copy of any data generated during the site visit and/or any final report produced.
4) If the NYSDEC determines that an update of the SMP is necessary, the RP shall update the SMP and obtain final approval from the NYSDEC. Within 5 business days after NYSDEC approval, the RP shall submit a copy of the approved SMP to the owner(s).
5) The RP shall notify the NYSDEC and the owner of any changes in RP ownership and/or control and of any changes in the party/entity responsible for the maintenance and reporting with respect to any Engineering Control. The RP shall provide contact information for the new party/entity. Such activity constitutes a Change of Use pursuant to 375-1.11(d) and requires 60-days prior notice to the NYSDEC. A 60-Day Advance Notification Form and Instructions are found at http://www.dec.ny.gov/chemical/76250.html .
6) The RP shall notify the NYSDEC of any damage to or modification of the Engineering Control as required under Section D-1: Notifications of the SMP.
7) Prior to a change in use that impacts the Engineering Control or requirements and/or responsibilities for implementing the SMP, the RP shall submit to the NYSDEC for approval an amended SMP.
8) Any change in use, change in ownership, change in site classification (*e.g.*, delisting), reduction or expansion of remediation, and other significant changes related to the site may result in a change in responsibilities and, therefore, necessitate an update to the SMP and/or updated legal documents. The RP shall contact the Department to discuss the need to update such documents.

Change in RP ownership and/or control and/or site ownership does not affect the RP's obligations with respect to the site unless a legally binding document executed by the NYSDEC releases the RP of its obligations.

Future site owners and RPs and their successors and assigns are required to carry out the activities set forth above.

PLATES

1. Remaining Soil Sample Exceedances and Cleanup Tracks Achieved
2. Site Cover System



SVA-SB-4	11/20/2020	11/20/2020
Depth (ft bls)	18 - 20	20 - 22
Metals		
Barium	**465**	NE
Lead	**942**	NE
Mercury	**5.35**	NE
Silver	**4.12**	ND
Zinc	**455**	NE
Pesticides		
Dieldrin	**0.00737**	**0.0226**
P,P'-DDD	**0.00498**	**0.00672**
P,P'-DDE	**0.026**	**0.0782**
P,P'-DDT	**0.0954**	**0.242**

BCS-2	02/11/2022
Depth (ft bls)	15 - 17
Pesticides	
P,P'-DDE	**0.00345**
P,P'-DDT	**0.0102 J**

SVA-SB-1	11/19/2020	11/23/2020
Depth (ft bls)	2 - 4	15 - 17
SVOCs		
Benzo(A)Anthracene	**2.1**	**1.2**
Benzo(A)Pyrene	**2.6**	**1.2**
Benzo(B)Fluoranthene	**3.8**	**1.4**
Benzo(K)Fluoranthene	**1.2**	NE
Chrysene	**2.8**	**1.3**
Dibenz(A,H)Anthracene	**0.51**	NE
Indeno(1,2,3-C,D)Pyrene	**2**	**0.76**
Metals		
Barium	**691**	NE
Lead	**473**	NE
Mercury	**0.393**	ND
Zinc	**991**	NE
Pesticides		
Dieldrin	**0.0982**	NE
P,P'-DDD	**0.0209**	ND
P,P'-DDE	**0.107**	ND
P,P'-DDT	**0.555**	NE
PFAS		
Perfluorooctanesulfonic acid (PFOS)	**9.02 J**	NA
Perfluorooctanoic acid (PFOA)	**0.987 J**	NA

SDS-2	12/13/2021
Depth (ft bls)	10 - 10
Pesticides	
Dieldrin	**0.00842**
P,P'-DDD	**0.00529 J**
P,P'-DDE	**0.015**
P,P'-DDT	**0.0493**
PFAS	
Perfluorooctanesulfonic acid (PFOS)	**0.957**

SVA-SB-7	11/19/2020	11/19/2020
Depth (ft bls)	2 - 4	2 - 4 DUP
SVOCs		
Benzo(A)Anthracene	**3.6**	**5**
Benzo(A)Pyrene	**4.3**	**5.3**
Benzo(B)Fluoranthene	**5.7**	**7.4**
Benzo(K)Fluoranthene	**1.9**	**1.8**
Chrysene	**3.9**	**4.9**
Dibenz(A,H)Anthracene	**0.75**	**0.99**
Indeno(1,2,3-C,D)Pyrene	**3**	**4.4**
Metals		
Barium	**622**	**652**
Cadmium	**2.64 J**	NE
Lead	**265**	**261**
Mercury	**0.307**	**0.379**
Zinc	**869**	**567**
PCBs		
Polychlorinated Biphenyl (PCBs)	**0.109 J**	NE
Pesticides		
cis-Chlordane	**0.111**	NE
Dieldrin	**0.0544**	**0.0771**
P,P'-DDD	**0.0392**	**0.0231**
P,P'-DDE	**0.0551**	**0.0455**
P,P'-DDT	**0.285**	**0.354**
PFAS		
Perfluorooctanesulfonic acid (PFOS)	**4.98 J**	**4.38 J**

LEGEND

▬	BCP SITE BOUNDARY
SVA-SB-2 ●	LOCATION AND DESIGNATION OF SRI SOIL BORING USED AS BCS
BCS-1 ○	APPROXIMATE LOCATION AND DESIGNATION OF BCS
BDS-1 ○	APPROXIMATE LOCATION AND DESIGNATION OF BDS
SVA-SB-1 ●	LOCATION AND DESIGNATION OF SRI SOIL BORING USED AS BDS
SDS-1 ⌖	APPROXIMATE LOCATION AND DESIGNATION OF SDS
BCP	BROWNFIELD CLEANUP PROGRAM
BCS	BOTTOM CONFIRMATION SAMPLE
BDS	BOTTOM DOCUMENTATION SAMPLE
BLS	BELOW LAND SURFACE
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SDS	SIDEWALL DOCUMENTATION SAMPLE
SRI	SUPPLEMENTAL REMEDIAL INVESTIGATION
UST	UNDERGROUND STORAGE TANK

🟪	TRACK 4 – LIMITS OF SITE COVER SYSTEM COMPRISED OF CONCRETE BUILDING FOUNDATION AND SUB-BASE AGGREGATE BACKFILL. SEE DETAIL 1.
🟥	TRACK 2 – RESTRICTED RESIDENTIAL
🟪	TRACK 2 – RESIDENTIAL
🟩	TRACK 1 – UNRESTRICTED USE

TYPICAL DATA BOX INFORMATION

SAMPLE ID# → SDS-2
SAMPLE DATE → 12/13/2021
SAMPLE DEPTH → 10 - 10
ANALYTES
CONCENTRATION

SDS-2	12/13/2021
Depth (ft bls)	10 - 10
Pesticides	
Dieldrin	**0.00842**
P,P'-DDD	**0.00529 J**
P,P'-DDE	**0.015**
P,P'-DDT	**0.0493**
PFAS	
Perfluorooctanesulfonic acid (PFOS)	**0.957**

Parameter	NYSDEC Part 375 Unrestricted Use Soil Cleanup Objectives	NYSDEC Part 375 Residential Soil Cleanup Objectives	NYSDEC Part 375 Restricted Residential Soil Cleanup Objectives	Units
VOCs				
Acetone	**0.05**	100	100	mg/kg
SVOCs				
Benzo(A)Anthracene	**1**	1	1	mg/kg
Benzo(A)Pyrene	**1**	1	1	mg/kg
Benzo(B)Fluoranthene	**1**	1	1	mg/kg
Benzo(K)Fluoranthene	**0.8**	1	3.9	mg/kg
Chrysene	**1**	1	3.9	mg/kg
Dibenz(A,H)Anthracene	**0.33**	0.33	0.33	mg/kg
Indeno(1,2,3-C,D)Pyrene	**0.5**	0.5	0.5	mg/kg
Metals				
Barium	**350**	350	400	mg/kg
Cadmium	**2.5**	2.5	4.3	mg/kg
Lead	**63**	400	400	mg/kg
Mercury	**0.18**	0.81	0.81	mg/kg
Silver	**2**	36	180	mg/kg
Zinc	**109**	2200	10000	mg/kg
PCBs				
Polychlorinated Bipheny (PCBs)	**0.1**	1	1	mg/kg
Pesticides				
cis-Chlordane	**0.094**	0.91	4.2	mg/kg
Dieldrin	**0.005**	0.039	0.2	mg/kg
P,P'-DDD	**0.0033**	2.6	13	mg/kg
P,P'-DDE	**0.0033**	1.8	8.9	mg/kg
P,P'-DDT	**0.0033**	1.7	7.9	mg/kg
PFAS				
Perfluorooctanesulfonic acid (PFOS)	**0.88**	8.8	44	µg/kg
Perfluorooctanoic acid (PFOA)	**0.66**	6.6	33	µg/kg

mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
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

NOTES

1. BASEMAP ADAPTED FROM SURVEY NO. 65967-2 PREPARED BY MONTROSE SURVEYING CO., LLP, DATED FEBRUARY 1, 2019.
2. THE BUILDING FOOTPRINT COVERS THE ENTIRE BCP SITE.

Noelle M. Clarke
No. 072491
12/13/22

NO.	DATE	REVISION DESCRIPTION	INT.

UNAUTHORIZED ALTERATION OR ADDITION TO THIS DOCUMENT IS A VIOLATION OF STATE LAW.

THESE DOCUMENTS (OR COPIES OF ANY THEREOF) PREPARED BY OR BEARING THE SEAL OF THE ENGINEER, SHALL NOT BE REUSED FOR ANY EXTENSIONS OF THE PROJECT OR ANY OTHER PROJECT WITHOUT THE WRITTEN CONSENT OF THE ENGINEER.

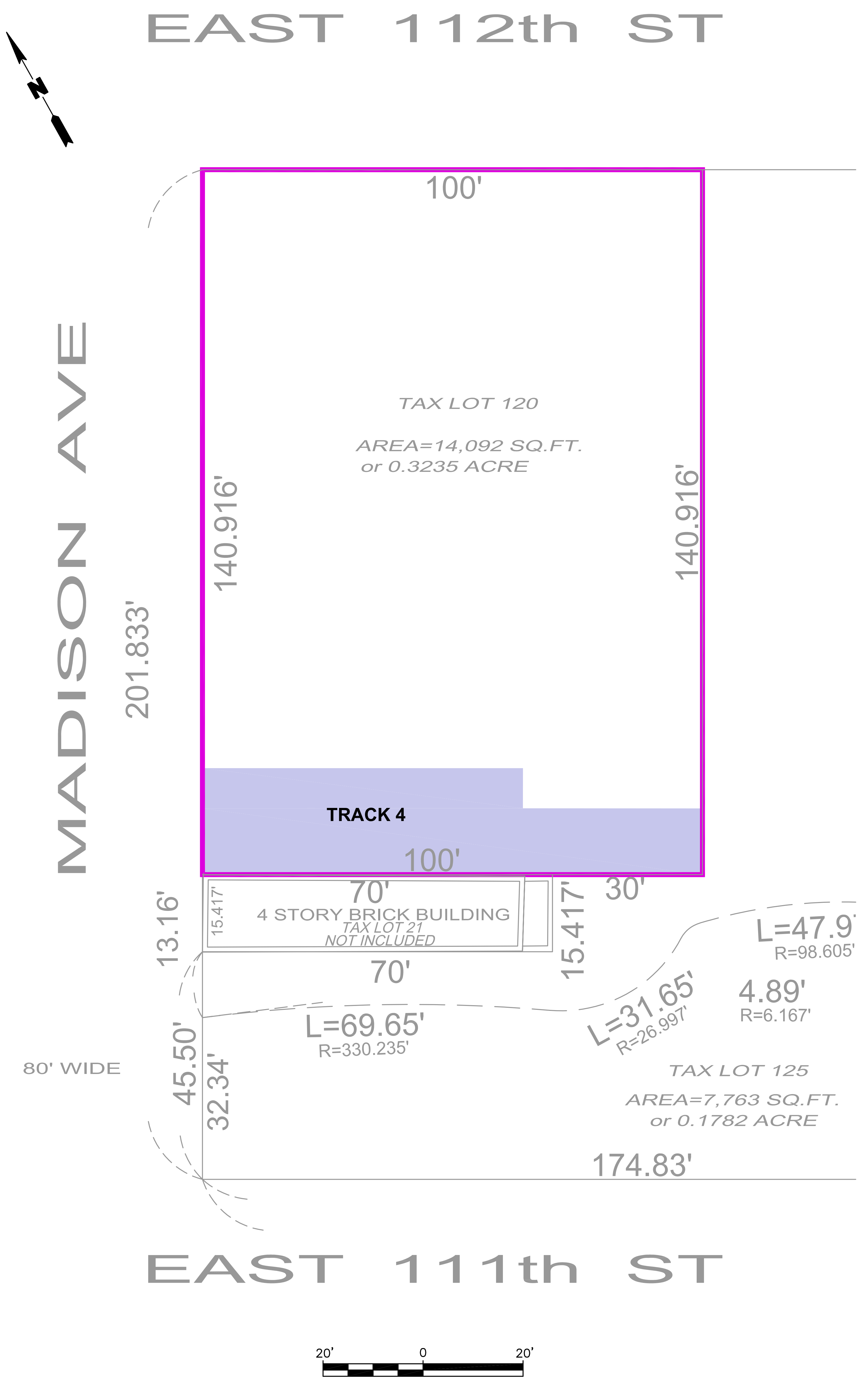
PROJ. ENGINEER: N.C.	DRAWN BY: B.H.C.
DESIGNED BY: N.C.	CHECKED BY: W.S.
DRAWING SCALE: AS SHOWN	PLOT SCALE: 1:1
DRAWING DATE: 12DEC22	PRINT TYPE: COLOR
OFFICE: NY	PAPER SIZE: ARCH D
PROJECT NO.: 2984.0002Y002	
DRAWING FILE: 2984.0002Y152.01.DWG	

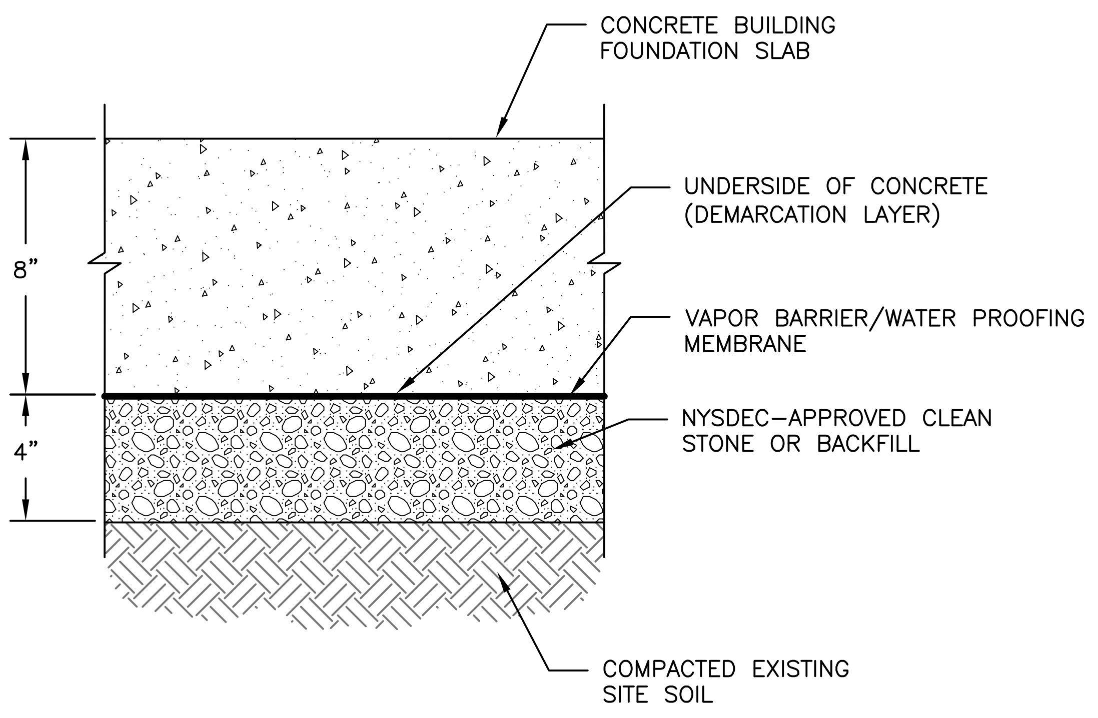
ROUX
Roux Environmental
Engineering and Geology, D.P.C.
209 SHAFTER STREET ISLANDIA NEW YORK 11749
(631) 232-2600

PROJECT NAME:
SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A
PROJECT FOR:
SV-A OWNERS LLC

TITLE:
REMAINING SOIL SAMPLE EXCEEDANCES
AND CLEANUP TRACKS ACHIEVED

PLATE
1





1 AS–BUILT SITE COVER SYSTEM: CONCRETE BUILDING FOUNDATION

SCALE: NOT TO SCALE

LEGEND

━	BCP SITE BOUNDARY
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
BCP	BROWNFIELD CLEANUP PROGRAM
🟪	TRACK 4 – LIMITS OF SITE COVER SYSTEM COMPRISED OF CONCRETE BUILDING FOUNDATION AND SUB–BASE AGGREGATE BACKFILL. SEE DETAIL 1.

NOTE

1. BASEMAP ADAPTED FROM SURVEY NO. 65967–2 PREPARED BY MONTROSE SURVEYING CO., LLP, DATED FEBRUARY 1, 2019.
2. THE BUILDING FOOTPRINT COVERS THE ENTIRE BCP SITE.

Noelle M. Clarke
No. 072491
12/13/22

V:\CAD\PROJECTS\2984Y\0002Y\152\2984.0002Y152.03.DWG

NO.	DATE	REVISION DESCRIPTION	INT.

UNAUTHORIZED ALTERATION OR ADDITION TO THIS DOCUMENT IS A VIOLATION OF STATE LAW.

THESE DOCUMENTS (OR COPIES OF ANY THEREOF) PREPARED BY OR BEARING THE SEAL OF THE ENGINEER, SHALL NOT BE REUSED FOR ANY EXTENSIONS OF THE PROJECT OR ANY OTHER PROJECT WITHOUT THE WRITTEN CONSENT OF THE ENGINEER.

PROJ. ENGINEER: N.C.	DRAWN BY: B.H.C.
DESIGNED BY: N.C.	CHECKED BY: B.V.
DRAWING SCALE: AS SHOWN	PLOT SCALE: 1:1
DRAWING DATE: 12DEC22	PRINT TYPE: COLOR
OFFICE: NY	PAPER SIZE: ARCH D
PROJECT NO.: 2984.0002Y002	
DRAWING FILE: 2984.0002Y152.03.DWG	

ROUX
Roux Environmental
Engineering and Geology, D.P.C.
209 SHAFTER STREET ISLANDIA NEW YORK 11749
(631) 232-2600

PROJECT NAME:
SENDERO VERDE
REDEVELOPMENT PROJECT - PARCEL A

PROJECT FOR:
SV-A OWNERS LLC

TITLE:
SITE COVER SYSTEM

FIGURE
2