

REMEDIAL INVESTIGATION WORK PLAN

for

**42-24 ORCHARD STREET SITE
43-01 TO 43-43 QUEENS STREET AND 42-22 TO 42-24 ORCHARD STREET
LONG ISLAND CITY, QUEENS, NY 11101
BLOCK 265, LOT 13**

NYSDEC BROWNFIELD CLEANUP PROGRAM SITE NO.: TBD

TRC PROJECT NO. 350304

APRIL 2021

Submitted to:

New York State Department of Environmental Conservation
47-40 21st Street, Long Island City, New York 11101

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CERTIFICATIONS

I, Kevin Boger, P.E., certify that I am currently a registered professional engineer licensed by the State of New York and that this Remedial Investigation Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

I certify that all information and statements in this certification 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.



Kevin Boger, P.E.
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April 27, 2021

Date

It is a violation of Article 130 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by the New York State licensed engineer identified above in accordance with Section 7209(2), Article 130, New York State Education Law.

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1.0 INTRODUCTION

The purpose of this Remedial Investigation Work Plan (RI Work Plan) is to present to the New York State Department of Environmental Conservation (NYSDEC), for review and approval, the proposed plan for further investigation at 42-24 to 42-24 Orchard Street and 43-01 to 43-43 Queens Street, Long Island City, Queens, New York 11101 (referred to as the “Site”). The Requestor intends to enroll into the New York State Brownfield Cleanup Program (BCP) as a volunteer and will implement this RIWP pursuant to a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC). A BCP Application has been submitted concurrently with this RIWP for NYSDEC review. The proposed BCP Site name is “42-24 Orchard Street.”

The overall objectives of the Remedial Investigation (RI) is to investigate and characterize the nature and extent of environmental impacts at the Site and to provide sufficient information to evaluate remedial alternatives, as required. This RI Work Plan will be implemented in accordance with the protocols in NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10) and the New York State Department of Health (NYSDOH) “Guidance for Evaluating Soil Vapor Intrusion in the State of New York” (October 2006).

Following completion of the RI, NYCSCA will submit an RI Report documenting the findings and conclusions of the investigation. The RI Report will also present the results of previous investigations.

2.0 SITE DESCRIPTION AND HISTORY

2.1 Site Location and Setting

The Site is located at 42-22 to 42-42 Orchard Street and 43-01 to 43-43 Queens Street, Queens, NY 11101. The legal description of the Site is Block 265, Lot 13. The Site formerly consisted of four lots (Lots 1, 6, 13, and 23) and were recently merged into one lot. The Site location is shown on *Figure 1*. The Site encompasses approximately 82,400 square feet (sf) (+/- 1.89 acres) and is improved with a total of five buildings, as follows:

- 42-24 Orchard Street is a five (5) story structure that is occupied by manufacturers (textiles, clothing, and handbags), woodworking companies, commercial tenants and storage spaces with vacant offices;
- 43-27 to 43-43 Queens Street is a one story structure that is used for contract storage;
- 43-15 to 43-25 Queens Street is a three story structure that is occupied by a food cart/truck storage facility, woodworking company, a textile/clothing manufacturer, and a party supplier;
- 43-01 Queens Street is a two-story building with a basement occupied by a scrap metal recycling company; and,
- 42-22 Orchard Street is a two-story slab on grade building occupied by a woodworking company.

The remaining areas of the Site are occupied by an asphalt-paved valet parking lot.

The Site is bordered to the north by Jackson Avenue, followed by a hotel, a three-story vacant building, 42nd Road, and a commercial/office high-rise; to the east by Orchard Street, followed by a commercial/residential high-rise and a parking garage; to the south by the New York City Metropolitan Transportation Authority (NYCMTA) yard and subway; and to the west by Queens Street, followed by a taxi stand/repair facility, automobile garages, and a commercial/residential high-rise. Beyond the properties immediately adjacent to the Site, property uses are commercial, residential, and manufacturing. A Site Plan showing the surrounding properties is presented as *Figure 2*.

According to the New York City Department of City Planning (NYCDCP) Zoning Map 9b, the Site is zoned M1-5/R9 for mixed-use (residential, light manufacturing, and commercial). No zoning changes are required for development of the Site.

2.2 Historic Site Use

Historical records indicate that the Site was sparsely developed with stores, residential dwellings, stables, and a laundry facility in 1898. The laundry facility operated until at least 1915. By 1915, the Site was developed with a shoe manufacturer (Rosenwasser Bros) along Orchard Street; the “Long Island Bill Posting Co” along Queens Street; and stores along Jackson Avenue. By 1936, the Site was occupied by “Fada Radio” and “Shelton Co Inc.” (a paper box manufacturer) along Orchard Street, “Bristol Co.” (a furniture manufacturer) along Jackson Avenue. A loft, wood working facility, and warehouses were present along Queens Street. By 1947, the “Bristol Co.” building was identified as a loft, a paper manufacturer is noted on the southwestern portion of the Site along Queens Street, and the buildings on the northern portion of the Site along Jackson Avenue were demolished and replaced with a parking lot.

2.3 Future Use of the Site and Site Development Schedule

The proposed future use of the Site is a high-rise residential tower with accessory two-story parking garage and ground floor retail. The contemplated project includes demolition of the existing buildings. Remedial actions under this Program are anticipated to begin in 2022. BLDG’s objective is to complete the remedy and obtain the Certificate of Completion by 2026.

2.4 Site Geology and Hydrogeology

Fill material consisting of brown sand, gravel, silt, and trace building materials (i.e., brick, concrete, aggregate, asphalt, wood, ash) was encountered in soil borings at the Site to maximum depths of approximately 13 feet bgs. The underlying material below the identified fill generally consists of tan fine sand with silty clay. Weathered bedrock and bedrock were encountered at depths ranging from approximately 4 to 12 feet bgs. Weathered bedrock is made up of metamorphic bedrock that has been softened by natural chemical weathering processes to the consistency of very compact soil, typically containing numerous embedded rock fragments (Mueser Rutledge, 2020). The layer of weathered bedrock consists of compact to very compact, gray and white fine to coarse sand, green gray clayey silt, some to trace silt, and gravel (Mueser Rutledge, 2020). Bedrock at the Site consists of hard to intermediate, unweathered to slightly weathered, gray gneiss with pink pegmatite and gray schistose gneiss zones, moderately jointed to closely jointed, with weathered and some healed joints (Mueser Rutledge, 2020). Depth to weathered bedrock and competent bedrock dips from approximately 0 feet bgs in the central portion of the Site to maximum depths of 50 feet bgs in the northern portion of the Site and 10 feet bgs in the southern portion of the Site.

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Based on review of the *USGS Hydraulic Conditions Map for Long Island, NY 2013 (USGS Long Island Depth to Water Viewer and Geospatial Dataset of Water-Table and Potentiometric-Surface Altitudes in the Upper Glacial, Magothy, and Lloyd Aquifers of Long Island, New York in 2013)*, groundwater flow in the vicinity of the Site is assumed to be towards the southwest. During the Phase II investigation, groundwater was encountered at depths ranging from approximately 6 to 11 feet bgs.

3.0 PREVIOUS INVESTIGATIONS

Previous environmental reports associated with the Site include a Phase I Environmental Site Assessment (ESA) Report prepared by TRC in July 2019 and a Phase II Environmental Site Investigation (ESI) Report prepared by TRC in April 2021. Brief summaries of these reports are provided below. Additionally, figures showing the exceedances of applicable criteria in soil, groundwater, and soil vapor are provided as Figures 3, 4, 5, and 6 respectively.

3.1 Phase I Environmental Site Assessment (ESA), July 2019

A Phase I ESA for the Site was completed by TRC in 2019 on behalf of BLDG. The Phase I ESA Report, dated July 31, 2019, identified on-Site recognized environmental conditions (RECs) associated with the potential presence of historic fill of unknown origin and suspect buried structures; current use of the Site as a manufacturer (including textile/clothing, woodworking, and hand bags); historic uses of the Site for laundry, wood working, and manufacturing (shoes, paper, and furniture); and regulatory database listings for hazardous waste generation and a registered dry cleaner. Off-Site RECs include the current presence of an active taxi stand/repair facility adjacent west of the Site (27-34 Jackson Avenue); the current presence of the New York City Metropolitan Transportation Authority (NYC MTA) yard and active subway lines adjacent and south of the Site; and the historical use of an adjacent facility east of the Site (28-02 to 28-30 Jackson Avenue) as a chemical manufacturer (West Chemical Company) with documented impacts to subsurface soil, groundwater, and soil vapor that was remediated under the BCP under Site Codes C241105, C241151, and C241169.

Based on the results of the Phase I ESA, TRC recommended performing a Phase II ESI. Environmental sampling was subsequently completed by TRC and is described below.

3.2 Phase II Environmental Site Investigation (ESI), April 2021

A Phase II ESI report for the Site was prepared by TRC in April 2021 on behalf of BLDG to assess the RECs identified in the Phase I ESA. Phase II ESI field activities consisted of geophysical surveys; advancement of soil borings; installation of temporary soil vapor probes and temporary groundwater monitoring wells; and the collection and laboratory analysis of sub-slab and soil vapor, soil, and groundwater samples. Soil samples were also collected from test pits advanced by others at the Site.

The results of the geophysical surveys revealed that the sample locations were established in areas that did not conflict with subsurface structures or utilities.

Acetone was detected in one (1) soil sample exceeding the Unrestricted Use SCOs and is attributed to laboratory contamination. Petroleum-related VOCs including (1,2,4-trimethylbenzene, benzene, ethylbenzene, m/p-xylenes, naphthalene, o-xylene, and total xylenes) were identified in one sample at concentrations exceeding the Unrestricted Use Soil Cleanup Objectives (UUSCOs) and/or Restricted Residential Use SCOs (RRSCOs). Based on the presence of petroleum odors, staining, and elevated PID readings up to 339 ppm that were encountered in the soil sample during collection, the petroleum related compounds detected in soil are attributable to an unidentified underground storage tank (UST) or a potential historic release.

SVOCs and metals were detected in soil at concentrations exceeding the UUSCOs and/or RRSCOs may be attributable to characteristics of fill material at the Site and/or the historic use of the Site as manufacturer (including shoes, furniture, and paper boxes). Mercury was detected in two samples at significantly elevated concentrations including the following: 40.1 milligrams per kilogram (mg/kg) in LOT-01-SB-02 and 14.3 mg/kg in TRC-SB-11. Lead was detected in one sample collected from the southern portion of the Site (TRC-SB-11) above the Toxicity Characteristic Leaching Procedure (TCLP) Regulatory Level. Polychlorinated biphenyls (PCBs) and pesticides were detected in soil samples at concentrations exceeding UUSCOs and/or RRSCOs and may be attributed to characteristics of fill material at the Site.

Petroleum-related VOCs (including 1,2,4-trimethylbenzene, 1,2-dichlorobenzene, 1,3,5-trimethylbenzene, 1,4-dichlorobenzene, ethylbenzene, Isopropylbenzene, m-Xylene & p-Xylene, Naphthalene, N-Propylbenzene, o-Xylene, and total xylenes) and SVOCs (including 1,1'-Biphenyl, Anthracene, Fluoranthene, Fluorene, Naphthalene, Phenanthrene) were detected in one (1) groundwater sample at concentrations exceeding the Class GA Value. A sheen and odor were noted during purging and petroleum odors, staining, and elevated PID readings were encountered in the corresponding soil boring (TRC-SB-10). Petroleum related compounds detected in groundwater may be attributed to an unidentified UST or a potential historic release. One SVOC, phenol, was detected in one groundwater sample and may be attributable to an unidentified UST or a potential historic release. Metals (iron, magnesium, manganese, selenium, and sodium) were detected in filtered groundwater samples and were attributed to the characteristics of Site soil/fill. No PCBs, Pesticides, or Herbicides were detected in groundwater at concentrations above the Class GA Value.

Several chlorinated and petroleum-related VOCs were detected at elevated concentrations in soil vapor samples. Specifically, total benzene, toluene, ethylbenzene and xylene (BTEX) compounds were detected at concentrations ranging from 14.4 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to 65,110 $\mu\text{g}/\text{m}^3$. Trichloroethene (TCE) was detected at concentrations ranging between 0.32 $\mu\text{g}/\text{m}^3$ to 32

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$\mu\text{g}/\text{m}^3$ and tetrachloroethene (PCE) was detected at concentrations ranging between 9.7 to 240 $\mu\text{g}/\text{m}^3$. Comparison of the sub-slab vapor analytical results to the NYSDOH Vapor Intrusion Guidance Matrices indicates that the recommended action would be monitor or mitigate, depending on the indoor air sampling results.

4.0 REMEDIAL INVESTIGATION OBJECTIVES AND METHODS

This section of the Work Plan presents the objectives and methods for the proposed additional investigation for the Site, and follows the guidance for an investigative work plan in NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation. The Work Plan has been prepared in consideration of the Site history and findings of previous investigations (refer to Sections 2.0 and 3.0).

4.1 Objectives

The principal objectives of the RI are to complete the characterization of soil, groundwater, and soil vapor at the Site and confirm groundwater flow direction. The data obtained during the implementation of the RI will be utilized for remedial action decisions.

The petroleum-related impacts previously identified during the Phase II ESI at one location, TRC-SB-10, will be further investigated as part of the RI and delineated. In addition, elevated concentrations of mercury were identified at two locations, LOT01-SB-01 and TRC-SB-11 and hazardous lead was detected at one location, TRC-SB-11. The elevated mercury and hazardous lead identified during the Phase II ESI will be further investigated as part of the RI and delineated.

4.2 Scope of Investigation

The scope of the planned field investigation activities has been organized into the following tasks:

- Task 1 – Utility Clearance and Geophysical Survey
- Task 2 – Soil Sampling
- Task 3 – Monitoring Well Installation and Development and Groundwater Sampling
- Task 4 – Vapor Intrusion Sampling
- Task 5 – Sample Location Survey
- Task 6 – Management of Investigation Derived Waste

Additionally, quality control and quality assurance procedures are summarized in the following task:

- Task 7 – Quality Assurance/Quality Control (QA/QC) Data Evaluation

The site-specific sampling techniques and analytical methods to be used in implementing the RI are presented in the Quality Assurance Project Plan (QAPP) in *Appendix A*. The investigation

activities will be performed in accordance with the CAMP and the Odor Monitoring and Mitigation Plan in *Appendix B* and the site-specific Health and Safety Plan (HASP) in *Appendix C*.

4.3 Task 1 – Utility Clearance and Geophysical Survey

Required New York One Call notifications will be made at least three days prior to intrusive work, and the locations of underground utility lines in public roads and rights-of-way will be marked out.

Prior to intrusive work activities, a geophysical survey will be performed to confirm the proposed sampling locations are clear of underground utilities. A geophysical subcontractor, under the supervision by TRC, will survey a 20-foot by 20-foot maximum area around each proposed boring/soil vapor sampling location for the purpose of identifying subsurface utilities prior to drilling. A narrative description of the results of the geophysical survey will be included in the RI Report. In addition, the RI Report will include a geophysical report, which provides a detailed summary of the geophysical activities as well as a site map noting the results of the survey.

4.4 Task 2 - Soil Sampling

TRC will advance seventeen (17) soil borings. Please refer to *Figure 7* for the proposed boring locations. The soil sampling program will include the following:

- A track-mounted direct push Geoprobe rig will be used to advance 4- or 5-foot long 2-inch diameter macrocore samplers lined with acetate sleeves to collect soil samples for the locations. Soil samples will be collected continuously to the following depths. Note that if indications of contamination are identified, the soil borings may be advanced deeper to delineate the extent of impacts, and additional borings may be advanced.
 - TRC-SB-02, TRC-SB-02-N, TRC-SB-02-E, TRC-SB-02-S, and TRC-SB-02-W will be advanced to a depth of approximately 20 feet bgs, or refusal, whichever is shallower.
 - TRC-SB-10-N, TRC-SB-10-E, TRC-SB-10-S and TRC-SB-10-W will be advanced to a depth of approximately 20 feet bgs, or refusal, whichever is shallower.
 - TRC-SB-11-N, TRC-SB-11-E, TRC-SB-11-S, and TRC-SB-11-W will be advanced to a depth of approximately 20 feet bgs, or refusal, whichever is shallower.
 - TRC-SB-23, TRC-SB-24, and TRC-SB-25 will be advanced to a depth of approximately (10) feet below the groundwater surface. Since groundwater is expected to be encountered at depths ranging between 6 and 11 feet bgs, it is

expected that the soil borings will be advanced to approximately 16 and 21 feet bgs.

- TRC-SB-26 and TRC-SB-27 will be advanced to a depth of approximately 20 feet bgs.
- Soil samples collected from each boring will be screened with a PID and inspected for indications of contamination (e.g., staining, odors, etc.). Geologic descriptions of the soil and field screening results will be recorded in field logs.
- Soil samples from the soil borings will be selected for laboratory analysis based on the following rationale:
 - If no apparent impacted soils are identified, soil samples selected from the following depth intervals for laboratory analysis:
 - TRC-SB-02, TRC-SB-02-N, TRC-SB-02-E, TRC-SB-02-W, and TRC-SB-02-S: Soil samples will be selected from 1 to 2 feet bgs or below the top of slab (btos) below concrete/asphalt and sub-base material to horizontally delineate the extent of impacts in LOT01-SB-02.
 - TRC-SB-10-N, TRC-SB-10-E, TRC-SB-10-S and TRC-SB-10-W: Soil samples will be selected from 0 to 2 feet bgs or btos below concrete/asphalt and sub-base material to horizontally delineate the extent of impacts in TRC-SB-10 and one sample will be collected from the two-foot interval directly above groundwater.
 - TRC-SB-11-N, TRC-SB-11-E, TRC-SB-11-S, and TRC-SB-11-W: Soil samples will be selected from 0 to 2 and 4 to 6 feet bgs to horizontally delineate the extent of impacts in TRC-SB-11.
 - TRC-SB-23, TRC-SB-24, and TRC-SB-25: Soil samples will be selected from 0 to 2 feet bgs and one sample will be collected from the two-foot interval directly above groundwater.
 - TRC-SB-26 and TRC-SB-27: Soil samples will be selected from 0 to 2 feet bgs.
 - If impacted soils are identified, one soil sample will be selected from the most impacted zone (based on field screening) and one soil sample will be selected from the first underlying apparent clean interval. If no apparent underlying clean interval is observed, the second soil sample submitted for analysis will be the sample collected

from the deepest interval of the boring.

- Soil samples from will be analyzed as follows:
 - TRC-SB-02, TRC-SB-02-N, TRC-SB-02-E, TRC-SB-02-W, and TRC-SB-02-S will be analyzed for total mercury. If the total mercury concentration is reported to be 20 times its respective RCRA TCLP limit, or greater, the sample will be additionally analyzed for TCLP mercury. One sample from TRC-SB-02-N will be additionally analyzed for PFAS compounds (refer to the QAPP in *Appendix A* for the specific list of PFAS compounds to be reported).
 - TRC-SB-10-N, TRC-SB-10-E, TRC-SB-10-W, and TRC-SB-10-S will be analyzed for Target Compound List (TCL) and NYSDEC CP-51-listed VOCs. One sample from TRC-SB-10-S will be additionally analyzed for PFAS compounds (refer to the QAPP in *Appendix A* for the specific list of PFAS compounds to be reported).
 - The 0 to 2 interval from TRC-SB-11-N, TRC-SB-11-E, TRC-SB-11-W, and TRC-SB-11-S will be analyzed for total mercury. If the total mercury concentration is reported to be 20 times its respective RCRA TCLP limit, or greater, the sample will be additionally analyzed for TCLP mercury. The 4 to 6 interval from TRC-SB-11-N, TRC-SB-11-E, TRC-SB-11-W, and TRC-SB-11-S will be analyzed for TCLP lead. One sample from TRC-SB-11-S will be additionally analyzed for PFAS compounds (refer to the QAPP in *Appendix A* for the specific list of PFAS compounds to be reported).
 - TRC-SB-23, TRC-SB-24, and TRC-SB-25 will be analyzed for full will be analyzed for Target Compound List (TCL) and NYSDEC CP-51-listed VOCs, TCL and CP-51-listed SVOCs, Target Analyte List (TAL) metals and cyanide, TCL pesticides, TCL herbicides, and PCBs.
 - TRC-SB-26 and TRC-SB-27 will be analyzed for PFAS compounds (refer to the QAPP in *Appendix A* for the specific list of PFAS compounds to be reported).
- Duplicate and equipment blank samples will be collected at a frequency of 1 per 20 soil samples and analyzed for the parameters listed above.
- Soil samples will be containerized in laboratory prepared jars, labeled, sealed, and placed in a chilled cooler for shipment to a NYSDOH Environmental Laboratory Approval

Program (ELAP)-certified laboratory for analysis. NYSDEC Analytical Services Protocol (ASP) Category B deliverable packages will be provided.

4.5 Task 3 – Monitoring Well Installation and Development and Groundwater Sampling

The work under this task includes the installation, development and sampling of three (3) permanent monitoring wells to assess groundwater conditions at the Site (refer to *Figure 7* for proposed monitoring well locations).

Groundwater monitoring well installation and sampling will include the following:

- Soil borings TRC-SB-23, TRC-SB-24, and TRC-SB-25 will be converted to permanent monitoring wells TRC-MW-23, TRC-MW-24, and TRC-MW-25 as described further below.
- Monitoring wells will be installed to approximately 10 feet below the observed water table. Each monitoring well will be constructed using 2-inch diameter polyvinyl chloride (PVC) monitoring well riser and screen. Each well will be screened from approximately 5 feet above the observed water table to 10 feet below the observed water table.
- Clean silica sand, Morie No. 1, or similar, will be placed in the annular space around each groundwater monitoring well to a minimum of one foot above the top of the well screen, two feet being optimal. A two-foot bentonite seal will be placed above the sand pack. The monitoring wells will be completed with a flush-mounted outer protective casing.
- Well construction diagrams will be prepared for each well.
- Following installation, the groundwater monitoring wells will be developed using backwashing or mechanical surging methods until three to five well volumes are removed and the water is reasonably free of turbidity and field parameter readings (temperature, conductivity, oxidation reduction potential (ORP), pH, and dissolved oxygen [DO]) sufficiently stabilize. During well development, TRC will actively monitor and track the volume of water purged and the field parameter readings. Field measurements will be recorded in a field logbook. Fifty nephelometric turbidity units (NTUs) or less will be the turbidity goal, but not an absolute value. The groundwater monitoring wells will be allowed to equilibrate for at least one week prior to sampling.
- On the day of groundwater sampling and prior to initiation of sampling activities, a synoptic round of water level measurements will be collected and the three on-Site wells (TRC-MW-23, TRC-MW-24, and TRC-MW-25) will be gauged for non-aqueous phase

liquid. Additionally, a headspace reading will be collected, using a PID, from each monitoring well location.

- Although not anticipated, if light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) is encountered, groundwater from that well will not be analyzed.
- Prior to sampling, groundwater from each well (TRC-MW-23, TRC-MW-24, and TRC-MW-25) will be purged until a minimum of three well volumes have been removed and field parameters have stabilized in accordance with USEPA Low-Stress (Low-Flow) sampling procedures. A turbidity level of 50 NTUs or less is the well purging goal. Other field parameters including temperature, conductivity, ORP, pH, and DO will also be monitored and, prior to sampling, field parameters should generally be within $\pm 10\%$ for three consecutive readings, three to five minutes apart. Ideally, pumping rates will be maintained between 100 and 500 milliliters per minute (ml/min) so that no drawdown of the groundwater level occurs (i.e., pumping rate is less than recharge rate). During purging, TRC will actively monitor and track the volume of water purged and the field parameter readings. Field measurements will be recorded in a field logbook. Once groundwater conditions have stabilized and groundwater levels have recovered, the samples will be collected.
- Groundwater samples collected from TRC-MW-23, TRC-MW-24, and TRC-MW-25, plus one duplicate and one equipment blank sample, will be analyzed for TCL and CP-51-listed VOCs, TCL and CP-51-listed SVOCs, TAL metals (field filtered and unfiltered), total cyanide, PCBs, TCL pesticides, TCL herbicides, 1,4-dioxane and per- and polyfluoroalkyl substances (PFAS)⁵. Additionally, one (1) trip blank sample will be analyzed for TCL and CP-51-listed VOCs.
- Groundwater samples will be containerized in laboratory supplied jars, labeled, sealed, and placed in a chilled cooler for shipment to the laboratory. Groundwater samples will be analyzed by an ELAP-certified laboratory approved by the NYSDOH and NYSDEC ASP Category B deliverable packages will be provided.

⁵ Refer to the QAPP (Appendix A) for the PFAS to be reported.

4.6 Task 4 – Sub-Slab Vapor Sampling

This task includes the collection of three co-located 8-hour duration sub-slab vapor/indoor air samples to determine the concentrations of VOCs in soil vapor and indoor air at the building located on Lot 6. The samples will be collected at the locations shown on *Figure 7*.

Sub-slab vapor and indoor air sampling will be conducted in accordance with the NYSDOH “Guidance for Evaluating Soil Vapor Intrusion in the State of New York” and ASTM International (ASTM) Standard E 2600-10.

The sub-slab vapor samples will be collected using a jackhammer or direct-drive rig (i.e., Geoprobe) to advance the vapor point to the desired sample depth. Sub-slab vapor samples will be generally collected at a depth of 0 to 2 inches below the bottom of the floor slab. The adequacy of each seal will be tested in accordance with the NYSDOH-approved method for vapor sampling using a 5-gallon bucket or cardboard box placed over the soil vapor sampling point and sealed from the ambient air using bentonite. Helium tracer gas will then be pumped into the bucket. The above grade end of the tubing, which is the sample collection point, will then be attached to a helium gas detector. The adequacy of the seal will be verified by direct helium readings of less than 10 percent.

The temporary sub-slab vapor probes will be purged using a PID to evacuate one to three volumes of soil vapor. The concentrations of ionizable vapors measured with the PID will be recorded. After purging, each probe will be connected via Teflon tubing to a laboratory-supplied individually certified clean 6-liter SUMMA canister and an 8-hour flow controller.

The indoor air samples will be collected concurrently with the sub-slab vapor samples utilizing individually certified-clean laboratory-supplied 6-liter SUMMA canisters with 8-hour flow controllers. The indoor air samples will be collected at a height of approximately 3 to 5 feet to simulate a typical breathing zone.

After sample collection, the soil vapor samples will be shipped overnight to an ELAP-certified laboratory for analysis of VOCs by USEPA Method TO-15. Method TO-15 will provide detection limits of 0.20 $\mu\text{g}/\text{m}^3$ for carbon tetrachloride, cis-1,2-DCE, 1,1-dichloroethene, TCE, and vinyl chloride allowing for comparison with the lowest action levels for these compounds in the NYSDOH “Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York”. The detection limit for all other compounds will be 1 $\mu\text{g}/\text{m}^3$. The soil vapor samples will be analyzed for VOCs listed in the QAPP (refer to *Appendix A*). NYSDEC ASP Category B deliverable packages will be provided.

Following sampling, soil vapor probes will be removed and the ground surface will be restored (i.e., patched with concrete).

4.7 Task 5 – Sample Location Survey

The coordinates and elevations of the top of the casing of each permanent monitoring well and the adjacent ground surface will be surveyed to determine water table elevations and groundwater gradient. The survey will be performed by a land surveyor licensed to practice in the State of New York. Additionally, ground surface elevations in the vicinity of the 2019 and 2020 Phase II ESI sampling locations will be surveyed to aid in preparation of geologic cross-sections.

4.8 Task 6 – Management of Investigation Derived Waste

Investigation derived waste (IDW) is anticipated to include the following: decontamination fluids and well purge and development water, and soil cuttings. IDW will be containerized in New York State Department of Transportation-approved 55-gallon drums for off-site disposal. Used personal protective equipment (PPE) and disposable sampling equipment will be bagged as regular refuse and disposed as solid waste, unless grossly contaminated.

4.9 Task 7 – Quality Assurance /Quality Control (QA/QC)

A QA/QC program for the RI will be instituted to verify that the project analytical data objectives were met. The QA/QC program will be implemented consistent with the QAPP, which specifies the data quality objectives (DQOs) for each analytical parameter for the entire investigation. During the program, the collection of QC samples will be monitored to verify that the field QC samples are collected at the proper frequency. Finally, the QA/QC program will include data validation for analytical data generated during this RI, as specified in the QAPP (refer to *Appendix A*).

The results of the data validation will be summarized in Data Usability Summary Reports (DUSRs). Note that data validation will be performed on Phase II ESI analytical data samples collected prior to implementation of the RI; and the DUSRs will be included in the RI Report.

5.0 PROJECT PERSONNEL

Key project personnel and contact information are identified in the table below. Resumes of key TRC project personnel are in *Appendix D*.

Key Personnel and Contact Information

Name	Role	Phone Number
Kevin Boger, PE, TRC	TRC Remedial Engineer/Senior Project Engineer	(917) 983 - 3166
Emily Ebert, TRC	TRC Office Safety Coordinator TRC Project Manager	(347) 618 - 6526 cellular: (908) 451-0203
Sanjay Sharma, TRC	TRC Project Geologist	(212) 221-7822 cellular: (631) 645-1314
Charles Lambert, TRC	TRC Environmental Scientist	(929-388-7556 cellular: (267) 884-2686
Elizabeth Denly, TRC	TRC Quality Assurance Officer	(978) 970-5600

6.0 REPORTING

A comprehensive Remedial Investigation Report (RI Report) will be prepared after receipt of surveying and laboratory data. The RI Report will conform to the guidelines set forth in NYSDEC DER-10 Sections 3.14 (Remedial Investigation Report) to the extent consistent with the scope of the investigation described above and to the extent necessary and applicable. The RI Report will include the following:

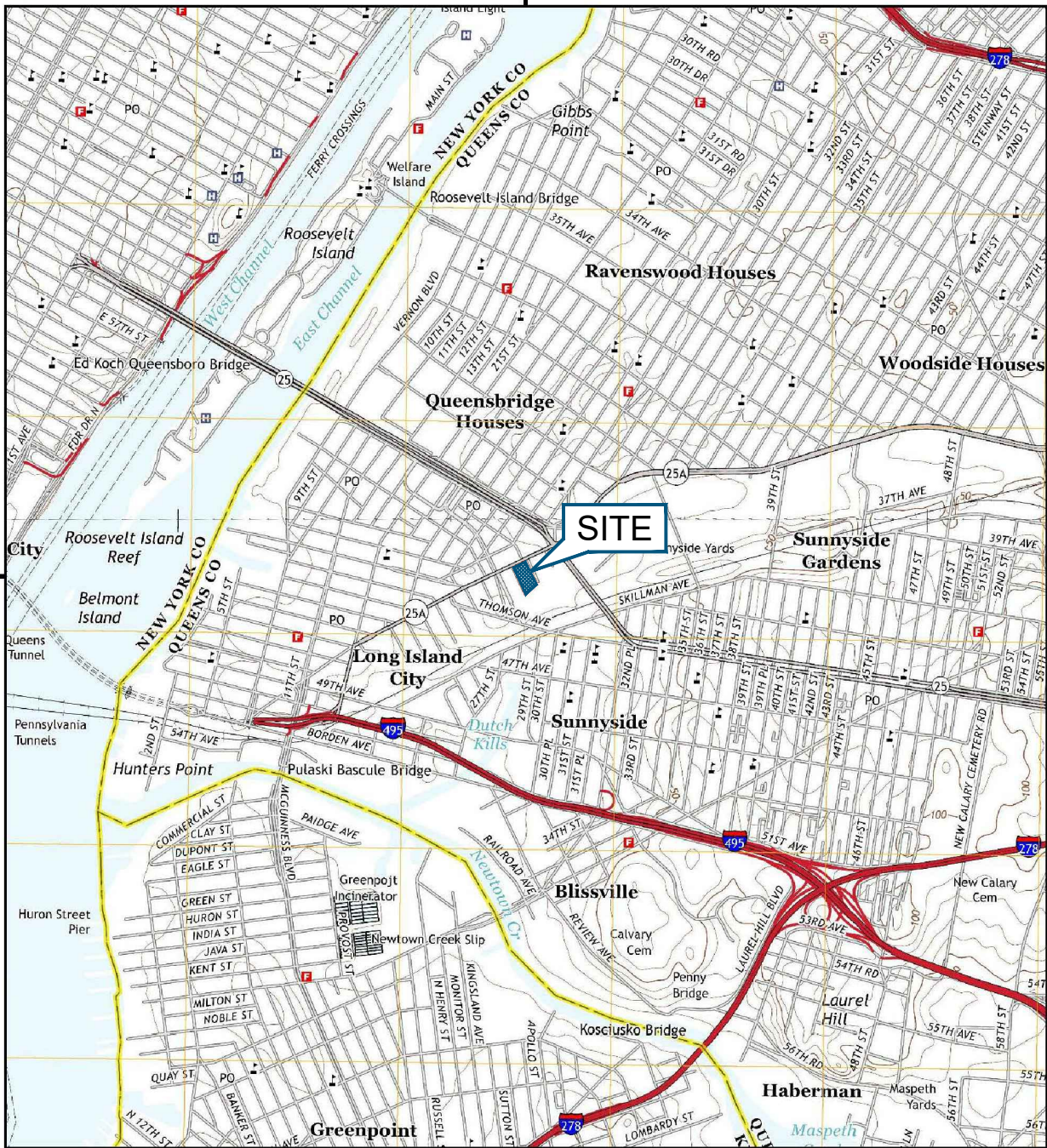
- Summaries of historic data and the results of prior investigations;
- A description of the scope of the Remedial Investigation;
- Descriptions of investigation methods;
- Scaled Site plan showing sampling locations;
- Field sample screening data and documentation (logs, chain-of-custody forms, etc.);
- Results of analyses of samples, including laboratory data packages, and a discussion of the findings;
- Data Usability Summary Reports;
- Map summarizing the results of the sampling, showing locations of and highlighting exceedances of relevant regulatory standards, criteria, and guidance;
- Groundwater surface elevation contour map showing apparent gradients and inferred predominant local groundwater flow directions;
- Geologic cross sections;
- A Fish and Wildlife Analysis;
- Qualitative Human Health Exposure Assessment and Conceptual Site Model; and,
- An analysis and discussion with a supporting drawing showing the estimated overall extent of contamination, if appropriate.

7.0 SCHEDULE

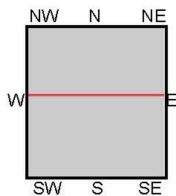
It is anticipated that the RI Work Plan will be implemented following the execution of the Brownfield Cleanup Agreement (BCA) and NYSDEC approval of the RI Work Plan. Presented below are estimated completion dates for key milestones associated with implementation of the Remedial Investigation.

<u>KEY MILESTONE</u>	<u>ESTIMATED TIME TO COMPLETION IN CALENDAR DAYS FROM EXECUTION OF THE BCA</u>
Execution of the BCA and NYSDEC Approval of RI Work Plan	0
Begin Remedial Investigation Field Activities	15
Complete Remedial Investigation (including laboratory analyses)	45
Submit Remedial Investigation Report to NYSDEC	90

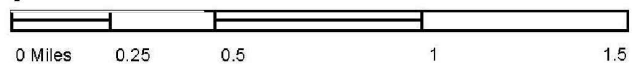
FIGURES



This report includes information from the following map sheet(s).



TP, Brooklyn, 2013, 7.5-minute
N, Central Park, 2013, 7.5-minute



SITE NAME: 42-22,42-24 Orchard St,43-01,43-43,43-1
ADDRESS: 42-22,42-24 Orchard St,43-01,43-43,43-1
Long Island City, NY 11101



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New York, NY 10018
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43-01 TO 43-43 QUEENS STREET & 42-22 TO 42-24 ORCHARD STREET
BLOCK: 265, LOTS: 1, 6, 13, & 23
LONG ISLAND CITY, QUEENS, NEW YORK 11101

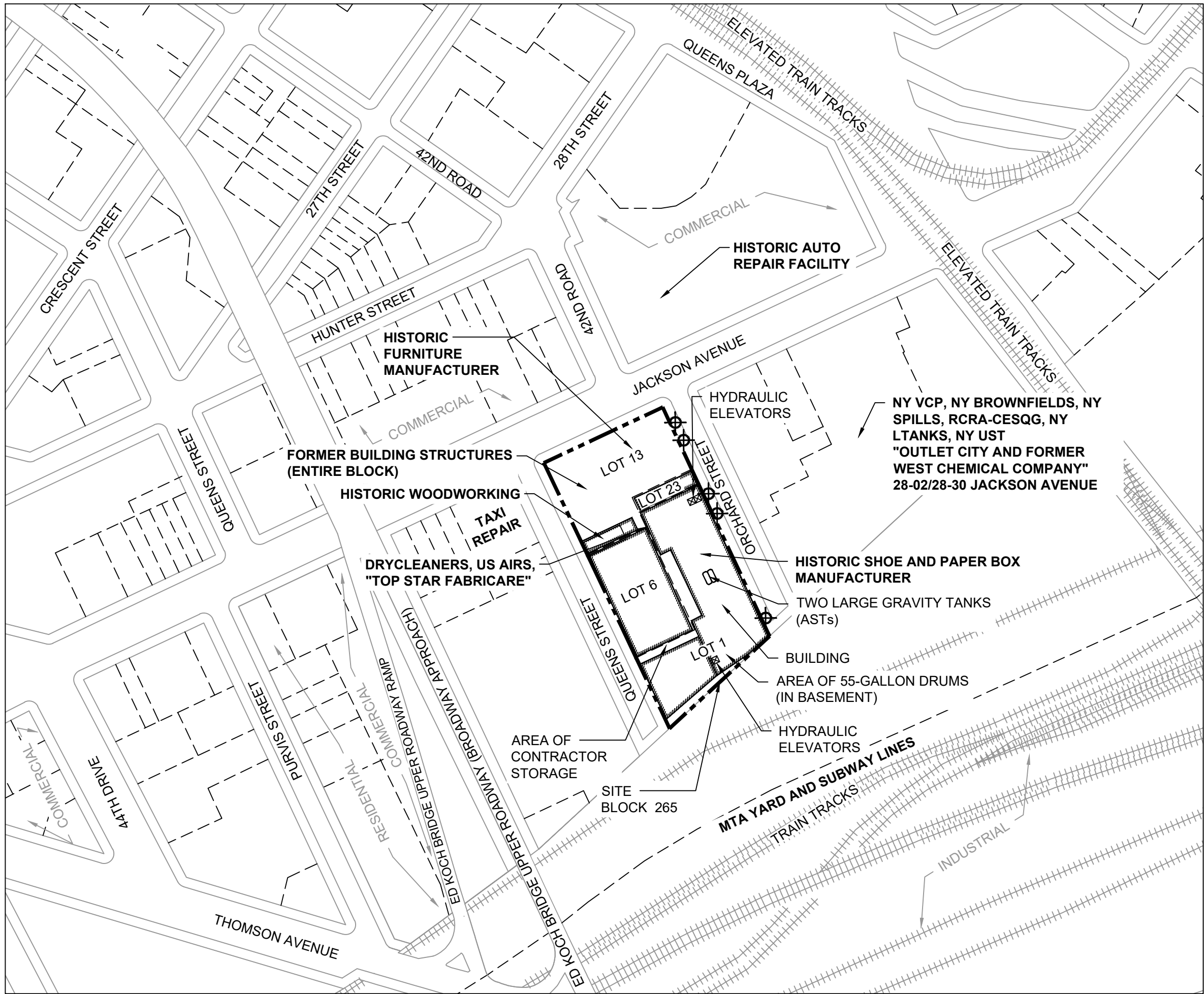
TITLE:

SITE LOCATION MAP

DRAWN BY: H. DELGADO
CHECKED BY: E. EBERT
APPROVED BY: K. BOGER
DATE: APRIL 2021
PROJ. NO.: 350304
FILE: Figure 1 - Site Location Map (42-24).dwg

FIGURE 1

11x17 -- ATTACHED XREFS: Queens -- ATTACHED IMAGES: Digital Tax Map (42-24); ESRI Database Image (08.03.18 (42-24)); ESRI Database Image (08.03.18 (42-24) North); Figure 3 - Sample Location Plan; Prop. Sheet Image (42-24);
DRAWING NAME: I:\Projects\350304 - 42-24 Orchard Street Long Island City\BCP Application\BCP Application Form\2 RI Work Plan\Figures\ Figure 2 - Site Plan (42-24).dwg -- PLOT DATE: April 12, 2021 - 10:15PM -- LAYOUT: 11X17L

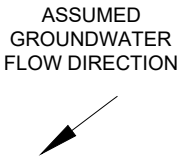
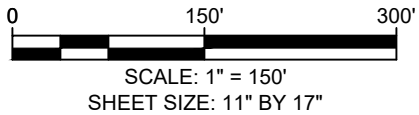


LEGEND (SYMBOLS NOT TO SCALE):

	SITE BOUNDARY
	LOT BOUNDARY
	BUILDING FOOTPRINT
AST	ABOVEGROUND STORAGE TANK
CESQG	CONDITIONALLY EXEMPT SMALL QUANTITY GENERATOR
EDR	ENVIRONMENTAL DATA RESOURCES
LTANKS	LEAKING STORAGE TANK INCIDENT REPORT
RCRA	RESOURCE CONSERVATION AND RECOVERY ACT
US AIRS	UNITED STATES AEROMETRIC INFORMATION RETRIEVAL SYSTEM
UST	UNDERGROUND STORAGE TANK
VCP	VOLUNTARY CLEANUP PROGRAM
	MONITORING WELL LOCATION

NOTE:

1. RECOGNIZED ENVIRONMENTAL CONDITIONS ARE SHOWN IN **BOLD FONT**.



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LONG ISLAND CITY, QUEENS, NEW YORK 11101

TITLE: SITE PLAN

DRAWN BY:	H. DELGADO	PROJ NO.:	350304
CHECKED BY:	E. EBERT	FIGURE 2	
APPROVED BY:	K. BOGER		
DATE:	APRIL 2021		



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FILE NO.: Figure 2 - Site Plan (42-24).dwg

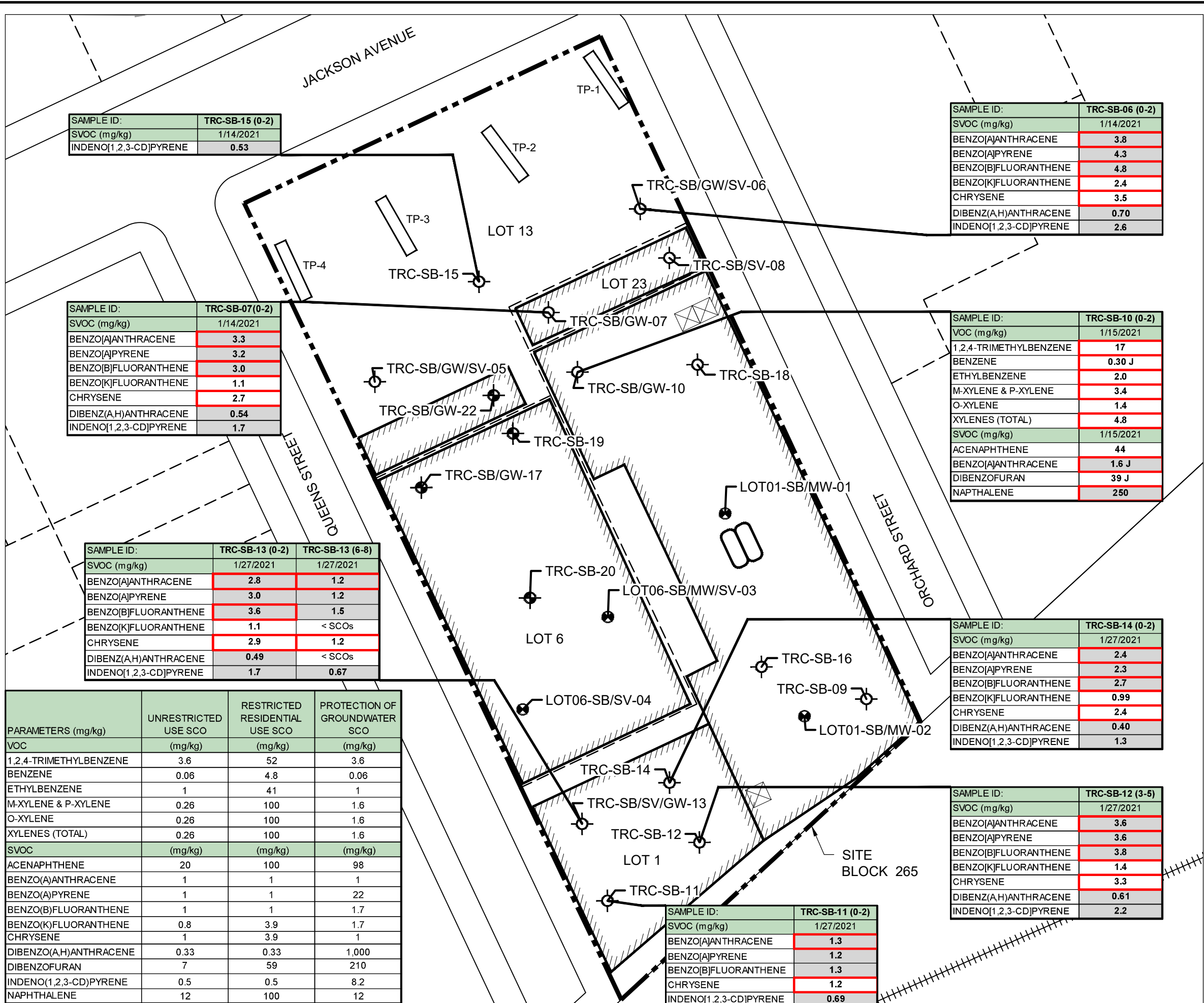
11x17 - ATTACHED XREFS: Queens - ATTACHED IMAGES: Digital Tax Map (42-24), ESRI Database Image 08.03.18 (42-24), ESRI Database Image 08.03.18 (42-24) North, Figure 3 - Sample Loc. Plan, Figure 3 - Test Pit Locations, Prop. Shark Image (42-24), DRAWING NAME: I:\Projects\350304 - 42-24 Orchard Street Long Island City BCP Application\BCP Application Form\2 RI Work Plan\Figures\Figure 3 - Sum. of VOC & SVOC Para. in Soil E.A. SCOs (42-24).dwg --- PLOT DATE: April 14, 2021 - 11:33AM --- LAYOUT: 11x17L

PARAMETERS (mg/kg)	UNRESTRICTED USE SCO	RESTRICTED RESIDENTIAL USE SCO	PROTECTION OF GROUNDWATER SCO
VOC	(mg/kg)	(mg/kg)	(mg/kg)
1,2,4-TRIMETHYLBENZENE	3.6	52	3.6
BENZENE	0.06	4.8	0.06
ETHYLBENZENE	1	41	1
M-XYLENE & P-XYLENE	0.26	100	1.6
O-XYLENE	0.26	100	1.6
XYLENES (TOTAL)	0.26	100	1.6
SVOC	(mg/kg)	(mg/kg)	(mg/kg)
ACENAPHTHENE	20	100	98
BENZO(A)ANTHRACENE	1	1	1
BENZO(A)PYRENE	1	1	22
BENZO(B)FLUORANTHENE	1	1	1.7
BENZO(K)FLUORANTHENE	0.8	3.9	1.7
CHRYSENE	1	3.9	1
DIBENZO(A,H)ANTHRACENE	0.33	0.33	1,000
DIBENZOFURAN	7	59	210
INDENO(1,2,3-CD)PYRENE	0.5	0.5	8.2
NAPHTHALENE	12	100	12

SAMPLE ID:	TRC-SB-13 (0-2)	TRC-SB-13 (6-8)
SVOC (mg/kg)	1/27/2021	1/27/2021
BENZO(A)ANTHRACENE	2.8	1.2
BENZO(A)PYRENE	3.0	1.2
BENZO(B)FLUORANTHENE	3.6	1.5
BENZO(K)FLUORANTHENE	1.1	< SCOs
CHRYSENE	2.9	1.2
DIBENZO(A,H)ANTHRACENE	0.49	< SCOs
INDENO(1,2,3-CD)PYRENE	1.7	0.67

SAMPLE ID:	TRC-SB-07(0-2)
SVOC (mg/kg)	1/14/2021
BENZO(A)ANTHRACENE	3.3
BENZO(A)PYRENE	3.2
BENZO(B)FLUORANTHENE	3.0
BENZO(K)FLUORANTHENE	1.1
CHRYSENE	2.7
DIBENZO(A,H)ANTHRACENE	0.54
INDENO(1,2,3-CD)PYRENE	1.7

SAMPLE ID:	TRC-SB-15 (0-2)
SVOC (mg/kg)	1/14/2021
INDENO(1,2,3-CD)PYRENE	0.53



SAMPLE ID:	TRC-SB-11 (0-2)
SVOC (mg/kg)	1/27/2021
BENZO(A)ANTHRACENE	1.3
BENZO(A)PYRENE	1.2
BENZO(B)FLUORANTHENE	1.3
CHRYSENE	1.2
INDENO(1,2,3-CD)PYRENE	0.69

SAMPLE ID:	TRC-SB-14 (0-2)
SVOC (mg/kg)	1/27/2021
BENZO(A)ANTHRACENE	2.4
BENZO(A)PYRENE	2.3
BENZO(B)FLUORANTHENE	2.7
BENZO(K)FLUORANTHENE	0.99
CHRYSENE	2.4
DIBENZO(A,H)ANTHRACENE	0.40
INDENO(1,2,3-CD)PYRENE	1.3

SAMPLE ID:	TRC-SB-10 (0-2)
VOC (mg/kg)	1/15/2021
1,2,4-TRIMETHYLBENZENE	17
BENZENE	0.30 J
ETHYLBENZENE	2.0
M-XYLENE & P-XYLENE	3.4
O-XYLENE	1.4
XYLENES (TOTAL)	4.8
SVOC (mg/kg)	1/15/2021
ACENAPHTHENE	44
BENZO(A)ANTHRACENE	1.6 J
DIBENZOFURAN	39 J
NAPHTHALENE	250

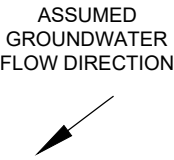
SAMPLE ID:	TRC-SB-06 (0-2)
SVOC (mg/kg)	1/14/2021
BENZO(A)ANTHRACENE	3.8
BENZO(A)PYRENE	4.3
BENZO(B)FLUORANTHENE	4.8
BENZO(K)FLUORANTHENE	2.4
CHRYSENE	3.5
DIBENZO(A,H)ANTHRACENE	0.70
INDENO(1,2,3-CD)PYRENE	2.6

LEGEND (SYMBOLS NOT TO SCALE):

- SITE BOUNDARY
- LOT BOUNDARY
- /// BUILDING FOOTPRINT
- LOT 0#-SB/MW/SV-## SOIL BORING, TEMPORARY MONITORING WELL, AND/OR SOIL VAPOR SAMPLING LOCATION AND IDENTIFICATION NUMBER (AUGUST 2020)
- ⊗ TRC-SB/GW/SV-## SOIL BORING, TEMPORARY MONITORING WELL, AND/OR SOIL VAPOR SAMPLING LOCATION AND IDENTIFICATION NUMBER (JANUARY 2021)
- ⊙ TRC-SB/GW/SV-## SOIL BORING, TEMPORARY MONITORING WELL, AND/OR SOIL VAPOR SAMPLING LOCATION AND IDENTIFICATION NUMBER (FEBRUARY 2021)
- TP-# TEST PIT LOCATION AND IDENTIFICATION NUMBER (MARCH 2021)

NOTES:

- LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.
- mg/kg - MILLIGRAMS PER KILOGRAM.
- SCO - SOIL CLEANUP OBJECTIVE.
- BLACK BOLDED TEXT EXCEEDS UNRESTRICTED USE SCO.
- BLACK BOLDED TEXT WITH GREY SHADING EXCEEDS UNRESTRICTED USE AND RESTRICTED RESIDENTIAL USE SCO.
- PARAMETERS OUTLINED IN RED ADDITIONALLY EXCEED THE PROTECTION OF GROUNDWATER USE SCO.
- CONCENTRATIONS OF ACETONE ABOVE REGULATORY CRITERIA, WHICH ARE ATTRIBUTED TO LABORATORY CONTAMINATION, ARE NOT SHOWN.
- ⁽¹⁾ - THERE IS NO SCO OR SCL FOR M/P-XYLENE OR O-XYLENE. THE SCO FOR TOTAL XYLENES IS USED.



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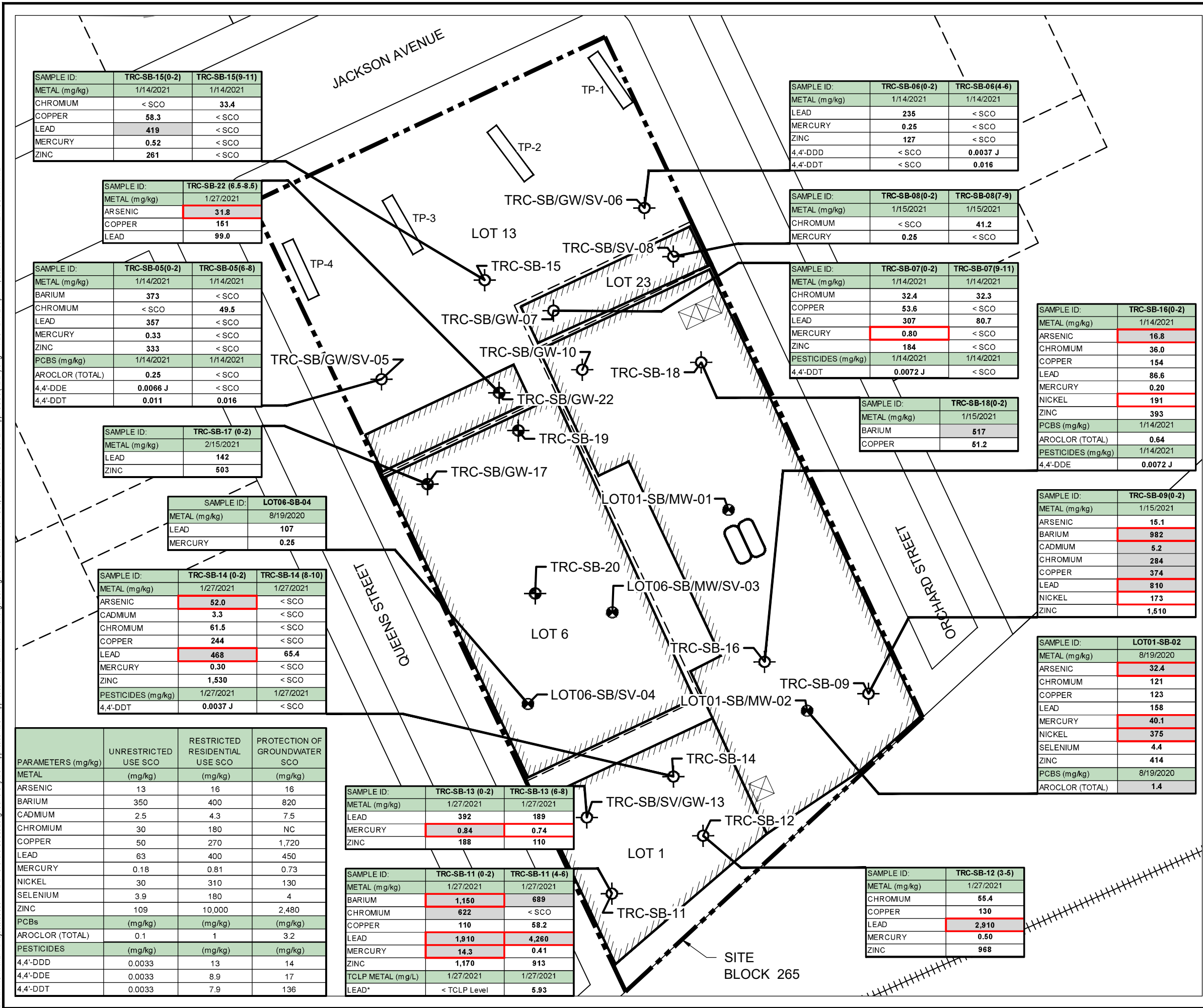
TITLE:
**SUMMARY OF VOC AND SVOC PARAMETERS
IN SOIL EXCEEDING APPLICABLE SCOs**

DRAWN BY: H. DELGADO
CHECKED BY: E. EBERT
APPROVED BY: K. BOGER
DATE: APRIL 2021


PROJ NO.: 350304
FIGURE 3

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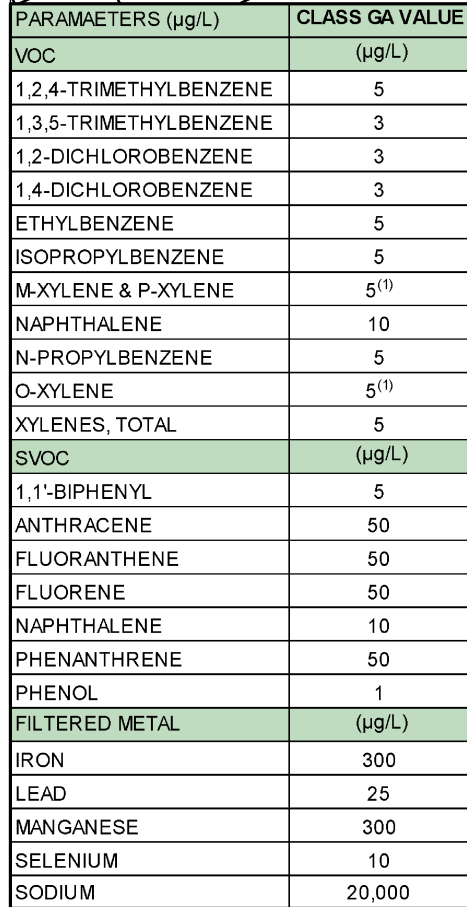
FILE NO.: Figure 3 - Sum. of VOC & SVOC Para. in Soil E.A. SCOs (42-24).dwg



ASSUMED
GROUNDWATER
FLOW DIRECTION




FILE # 42-24.dwg



ASSUMED
GROUNDWATER
FLOW DIRECTION



FILE NO.: Figure 5 - Sum. of Para. in GW Ex. Class GA Values (42-24).dwg

PROJECT: BLDG MANAGEMENT COMPANY, INC. 43-01 TO 43-43 QUEENS STREET & 42-22 TO 42-24 ORCHARD STREET BLOCK: 265, LOTS: 1, 6, 13, & 23 LONG ISLAND CITY, QUEENS, NEW YORK 11101	
TITLE: PROPOSED SAMPLE LOCATION PLAN	
DRAWN BY: H. DELGADO	PROJ NO.: 350304
CHECKED BY: E. EBERT	<div style="font-size: 2em; font-weight: bold;">FIGURE 7</div>
APPROVED BY: K. BOGER	
DATE: APRIL 2021	
<div style="display: flex; align-items: center;">  <div style="margin-left: 20px;"> <p>1430 Broadway, 10th Floor New York, NY 10018 Phone: 212.221.7822 www.TRCompanies.com</p> </div> </div>	
FILE NO.:	Figure 7 - Prop. Samp. Loc. Plan (42-24).dwg

**APPENDIX A
Quality Assurance Project Plan**

QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the field activities described in the scope of work. The QAPP also describes specific protocols for field sampling, sample handling and storage, and laboratory analysis. The data generated from the analysis of samples will be used to characterize soil, groundwater, and soil vapor at the Site; confirm groundwater flow direction at the Site; and, develop remedial action decisions.

Project Organization and Responsibility

A qualified person will coordinate and manage the sampling and analysis program, data reduction, QA/QC, data validation, analysis, and reporting. TRC will direct the sampling activities and coordinate laboratory and remedial investigation activities. The TRC Project Quality Assurance (QA) Officer will be Elizabeth Denly and will report directly to the Project Manager, Emily Ebert.

A qualified person will ensure that the QAPP is implemented and will oversee data validation. A qualified person will provide oversight and technical support for the sampling and analytical procedures followed in this project. This individual has the broad authority to approve or disapprove project plans, specific analyses, and final reports. The Project QA Officer is independent from the data generation activities. In general, the QA officer will be responsible for reviewing and advising on all QA/QC aspects of this program.

Laboratories used will be New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratories. The laboratories will communicate directly with the Project Manager regarding the analytical results and reporting and will be responsible for providing all labels, sample containers, trip blanks, temperature blanks, shipping coolers, and laboratory documentation.

QA Objectives for Data Management

New York State Analytical Services Protocol (ASP) Category B laboratory packages will be provided by the laboratory.

All analytical measurements will be made so that the results are representative of the media sampled and the conditions measured. Data will be reported in consistent dry weight units for solid samples (i.e., $\mu\text{g/kg}$ and/or mg/kg). Tables 1A-1C present the proposed samples, sampling and analytical parameters, analytical methods, sample preservation requirements, containers, and QA/QC samples.

Quantitation Limits (QLs) are laboratory-specific and reflect those values achievable by the laboratory performing the analyses.

Data Quality Levels (DQLs) are those reporting limits required to meet the objectives of the program (i.e., program action levels, cleanup standards, etc.).

Data Quality Objectives (DQOs) define the quality of data and documentation required to support decisions made in the various phases of the data collection activities. The DQOs are dependent on the end uses of the data to be collected and are also expressed in terms of objectives for precision, accuracy, representativeness, completeness, and comparability.

The analytical methods to be used at this site provide the highest level of data quality and can be used for purposes of risk assessment, evaluation of remedial alternatives and verification that cleanup standards have

been met. However, in order to ensure that the analytical methodologies are capable of achieving the DQOs, measurement performance criteria have been set for the analytical measurements in terms of accuracy and precision.

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting which will provide results that are scientifically valid, and the levels of which are sufficient to meet DQOs.

For quantitation limits for parameters associated with soil samples, the laboratory will be required to attempt to meet or surpass the parameter-specific limits listed in 6 NYCRR Part 375 Unrestricted Use Criteria and Commissioner Policy 51 Tables 2 and 3 (CP-51).

For quantitation limits for parameters associated with groundwater samples, the laboratory will be required to attempt to meet or surpass the parameter-specific limits for groundwater from the NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values.

For quantitation limits for parameters associated with soil vapor, the laboratory will be required to use Method TO-15, which will provide detection limits of 0.20 micrograms per cubic meter for vinyl chloride, trichloroethene (TCE), cis-1,2-dichloroethene, 1,1-dichloroethene, and carbon tetrachloride, allowing for comparison with the lowest action levels for these compounds in the NYSDOH “Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York”, dated October 2006. All other compounds will have a detection limit of 1 microgram per cubic meter.

The QA objectives are defined as follows:

- **Accuracy** is the closeness of agreement between an observed value and an accepted reference value. The difference between the observed value and the reference value includes components of both systematic error (bias) and random error.

Accuracy in the field is assessed through the adherence to all field instrument calibration procedures, sample handling, preservation, and holding time requirements, and through the collection of equipment blanks prior to the collection of samples for each type of equipment being.

The laboratory will assess the overall accuracy of their instruments and analytical methods (independent of sample or matrix effects) through the measurement of “standards,” materials of accepted reference value. Accuracy will vary from analysis to analysis because of individual sample and matrix effects. In an individual analysis, accuracy will be measured in terms of blank results, the percent recovery (%R) of surrogate compounds in organic analyses and/or laboratory control samples (LCSs). This gives an indication of expected recovery for analytes tending to behave chemically like the spiked or surrogate compounds. Tables 2A, 2B, 2B-1 and 2C summarize the laboratory accuracy requirements.

- **Precision** is the agreement among a set of replicate measurements without consideration of the “true” or accurate value: i.e., variability between measurements of the same material for the same analyte. Precision is measured in a variety of ways including statistically, such as calculating variance or standard deviation.

Precision in the field is assessed through the collection and measurement of field duplicates (one extra sample in addition to the original field sample). Field duplicates will be collected at a frequency of one per twenty investigative samples per matrix per analytical parameter. Precision

will be measured through the calculation of relative percent differences (RPDs). The resulting information will be used to assess sampling and analytical variability. These criteria apply only if the sample and/or duplicate results are $>5x$ the quantitation limit; if both results are $< 5x$ the quantitation limit, the criterion will be doubled.

Precision in the laboratory is assessed through the calculation of RPD for duplicate samples. For organic soil and groundwater analyses, laboratory precision will be assessed through the analysis of field duplicates.

- **Completeness** is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. “Normal conditions” are defined as the conditions expected if the sampling plan was implemented as planned.

Field completeness is a measure of the amount of (1) valid measurements obtained from all the measurements taken in the project and (2) valid samples collected. The field completeness objective is greater than 90 percent.

Laboratory completeness is a measure of the amount of valid measurements obtained from all valid samples submitted to the laboratory. The laboratory completeness objective is greater than 95 percent.

- **Representativeness** is a qualitative parameter that expresses the degree to which data accurately and precisely represents either a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. To ensure representativeness, the sampling locations have been selected to provide coverage over a wide area and to highlight potential trends in the data. In addition, field duplicate samples will provide an additional measure of representativeness at a given location.

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the RI Work Plan (Work Plan) are followed and that proper sampling, sample handling, and sample preservation techniques are used.

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, and meeting sample holding times.

- **Comparability** expresses the confidence with which one data set can be compared to another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the Work Plan are followed and that proper sampling techniques are used. Maximization of comparability with previous data sets is expected because the sampling design and field protocols are consistent with those previously used.

Comparability is dependent on the use of recognized United States Environmental Protection Agency (USEPA) or equivalent analytical methods and the reporting of data in standardized units. Laboratory procedures are consistent with those used for previous sampling efforts.

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX A
42-24 ORCHARD STREET SITE
BROOKLYN, NEW YORK 11101

Table 1A Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Soil Samples								
Sample Matrix	Analytical Parameter	Sample Type¹	No. of Samples²	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time³	Sample Container
Soil	TCL and CP-51 VOCs (includes 1,4-dioxane)	Grab	10-14	Duplicate: 1/20	8260C	Sealed in EnCore® bag; Cool to 4° C	48 hours to extract: 2 EnCore® samplers extruded in 5 mL DI water and freeze vials to <-7°C; 1 EnCore® sampler extruded in 5 mL methanol and Cool to 40 C; 14 days to analysis	3 x 5 gram EnCore® samplers
Soil	TCL and CP-51 SVOCs	Grab	10 - 16	Duplicate: 1/20	8270D	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	TAL Metals	Grab	6	Duplicate: 1/20	6010C	Cool to 4° C	Other metals: 180 days to analysis	8 oz glass jar
Soil	Mercury	Grab	15	Duplicate: 1/20	7471B	Cool to 4° C	Mercury: 28 days to analysis	8 oz glass jar
Soil	TCLP Mercury	Grab	0 - 4	Duplicate: 1/20	1311	Cool to 4° C +/-2°C	180 days to analysis	8 oz glass jar
Soil	TCLP Lead	Grab	0 - 4	Duplicate: 1/20	1311	Cool to 4° C +/-2°C	28 days to analysis	8 oz glass jar
Soil	Total Cyanide	Grab	6	Duplicate: 1/20	SW 846 9012B	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	TCL Pesticides	Grab	6	Duplicate: 1/20	8081B	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	TCL Herbicides	Grab	6	Duplicate: 1/20	8151A	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	PCBs	Grab	6	Duplicate: 1/20	8082A	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	PFAS ⁴	Grab	5	Duplicate: 1/20	537 Version 1.1	Cool to 4° C	14 days to extract	250 mL plastic HDPE jar
¹ A six-inch sampling interval is the targeted sample size; however, sample volume recovery, analytical method requirements, and field conditions can affect the actual sample interval size. For these reasons, the actual sampling interval may change in order to obtain adequate volume. ² Actual number of samples may vary depending on field conditions, sample material availability, and field observations. ³ From date and time of sample collection								

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⁴ Select list of 21 PFAS for analysis includes Perfluoroheptanoic acid (PFHpA), Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA), Perfluorobutanesulfonic acid (PFBS), Perfluorohexanesulfonic acid (PFHxS), Perfluorooctanesulfonic acid (PFOS), perfluoroheptanesulfonic acid (PFHpS), perfluorodecanesulfonic acid (PFDS), Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluorohexanoic acid (PFHxA), Perfluorodecanoic acid (PFDA), Perfluoroundecanoic acid (PFUA/PFUdA), Perfluorododecanoic acid (PFDoA), Perfluorotridecanoic acid (PFTrIA/PFTrDa), Perfluorotetradecanoic acid (PFTA/PFTeDA), 6:2 Fluorotelomer sulfonate (6:2 FTS), 8:2 Fluorotelomer sulfonate (8:2 FTS), Perfluorooctanesulfonamide (FOSA), N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA), N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA).

Table 1B Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Groundwater Samples								
Sample Matrix	Analytical Parameter	Sample Type	No. of Samples¹	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time²	Sample Container
Groundwater	TCL and CP-51 VOCs	Grab	3	Trip Blank ³ : as necessary (one per day, per cooler containing VOC groundwater samples) Duplicate: 1/20 Equipment Blank: 1/20	8260C	pH<2 with HCl; cool to 4°C; no headspace	14 days to analysis	3 40-mL glass vials
Groundwater	TCL and CP-51 SVOCs	Grab	3	Duplicate: 1/20 Equipment Blank: 1/20	8270D	Cool, 4°C	14 days to analysis	2 250-ml amber glass jar
Groundwater	TAL Metals (unfiltered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1/20	6010C	pH < 2 w/ HNO ₃ ; Cool, 4°C	Other Metals: 180 days to analysis	500 mL polyethylene bottle
Groundwater	TAL Metals (field filtered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1/20	6010C	pH < 2 w/ HNO ₃ ; Cool, 4°C	Other Metals: 180 days to analysis	500 mL polyethylene bottle
Groundwater	Mercury (unfiltered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1/20	7470A	pH < 2 w/ HNO ₃ ; Cool, 4°C	Mercury: 28 days to analysis	250 mL polyethylene bottle
Groundwater	Mercury (field filtered)	Grab	3	Duplicate: 1/20 Equipment Blank: 1/20	7470A	pH < 2 w/ HNO ₃ ; Cool, 4°C	Mercury: 28 days to analysis	250 mL polyethylene bottle
Groundwater	Total Cyanide	Grab	3	Duplicate: 1/20	SW 846-9012B	pH < 2 w/ NaOH; Cool, 4°C	14 days to extract	250 mL polyethylene bottle

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Table 1B Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Groundwater Samples								
Sample Matrix	Analytical Parameter	Sample Type	No. of Samples¹	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time²	Sample Container
Groundwater	TCL Pesticides	Grab	3	Duplicate: 1/20	8081B	Cool to 4° C	14 days to extract	2 250-ml amber glass jar
Groundwater	TCL Herbicides	Grab	3	Duplicate: 1/20	8151A	Cool to 4° C	14 days to extract	2 250-ml amber glass jar
Groundwater	PCBs	Grab	3	Duplicate: 1/20	8082A	Cool to 4° C	14 days to extract	2 250-ml amber glass jar
Groundwater	1,4-Dioxane ⁴	Grab	3	Duplicate: 1/20 Equipment Blank: 1/20	8270D SIM	Cool to 4°C	14 days to analysis	2 250-ml amber glass jar
Groundwater	PFAS ^{5,6}	Grab	3	Duplicate: 1/20 Equipment Blank: 1/20	537 Modified	Cool to 4 ± 2 °C	14 days to prepare, 28 days from preparation to analysis	2 x 250 mL HDPE ⁷ Bottles
¹ Actual number of samples may vary depending on field conditions, sample material availability, and field observations. ² From date and time of sample collection ³ Trip blank bottleware – 3 40-mL HCl-preserved glass vials ⁴ The method detection limit for 1,4-dioxane is 0.0160 ug/L ⁵ Select list of 21 PFAS for analysis includes Perfluoroheptanoic acid (PFHpA), Perfluorooctanoic acid (PFOA), Perfluorononanoic acid (PFNA), Perfluorobutanesulfonic acid (PFBS), Perfluorohexanesulfonic acid (PFHxS), Perfluorooctanesulfonic acid (PFOS), perfluoroheptanesulfonic acid (PFHpS), perfluorodecanesulfonic acid (PFDS), Perfluorobutanoic acid (PFBA), Perfluoropentanoic acid (PFPeA), Perfluorohexanoic acid (PFHxA), Perfluorodecanoic acid (PFDA), Perfluoroundecanoic acid (PFUA/PFUdA), Perfluorododecanoic acid (PFDoA), Perfluorotridecanoic acid (PFTrA/PFTrDa), Perfluorotetradecanoic acid (PFTA/PFTeDA), 6:2 Fluorotelomer sulfonate (6:2 FTS), 8:2 Fluorotelomer sulfonate (8:2 FTS), Perfluorooctanesulfonamide (FOSA), N-methyl perfluorooctanesulfonamidoacetic acid (N-MeFOSAA), N-ethyl perfluorooctanesulfonamidoacetic acid (N-EtFOSAA). ⁶ The reporting limit for PFAS compounds is 2 ng/L with the exception of N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA), N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA), 1H,1H,2H,2H-perfluorooctane sulfonate (6:2 FTS), and 1H,1H,2H,2H-perfluorodecane sulfonate (8:2 FTS). The reporting limit for these four PFAS is 20 ng/L. ⁷ HDPE – High density polyethylene								

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<p style="text-align: center;">Table 1C Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Soil Vapor Samples</p>								
Sample Matrix	Analytical Parameter	Sample Type	No. of Samples	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time¹	Sample Container
Sub-slab Soil Vapor	VOCs	Grab	3	None	TO-15	None	30 days to analysis	One 6-L Summa Canister
Indoor Air	VOCs	Grab	3	None	TO-15	None	30 days to analysis	One 6-L Summa Canister
¹ From date and time of sample collection								

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<p style="text-align: center;">Table 2A Laboratory Data Quality Objectives: Precision and Accuracy: Soil Samples</p>						
Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
TCL and CP-51 VOCs	8260C	Soil	<u>Surrogates</u> % <u>Rec.</u> 1,2-Dichloroethane-d4 78-135 4-Bromofluorobenzene 67-126 Toluene-d8 73-121 Dibromfluoromethane 61-149	<u>Surrogates:</u> All samples, standards, QC samples	<u>Field Duplicates</u> RPD ≤50	<u>Field Duplicates:</u> One per 20 soil samples
TCL and CP-51 SVOCs	8270D	Soil	<u>Surrogates</u> % <u>Rec.</u> 2-Fluorophenol 38-95 Phenol-d5 32-91 2,4,6-Tribromophenol 10-103 Nitrobenzene-d5 37-94 2-Fluorobiphenyl 38-95 Terphenyl-d14 24-109	<u>Surrogates:</u> All samples, standards, QC samples	<u>Field Duplicates</u> RPD ≤50	<u>Field Duplicates:</u> One per 20 soil samples
TAL Metals	6010C	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch <u>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples
Mercury	7471B	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch <u>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples
TCLP Mercury	1311	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples

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<p style="text-align: center;">Table 2A Laboratory Data Quality Objectives: Precision and Accuracy: Soil Samples</p>						
Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
Total Cyanide	SW 846-9012B	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch <u>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples
TCL Pesticides	8081B	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch <u>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples
TCL Herbicides	8151A	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch <u>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples
PCBs	8082A	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch <u>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples
PFAS	537.1	Soil	<u>Matrix Spikes:</u> 75-125% recovery <u>Laboratory Control Samples:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 soil samples per laboratory analytical batch	<u>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples

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Table 2A Laboratory Data Quality Objectives: Precision and Accuracy: Soil Samples						
Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
				Laboratory Control Samples: One per 20 samples per laboratory analytical batch		

Table 2B Laboratory Data Quality Objectives: Precision and Accuracy: Groundwater Samples						
Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
TCL and CP-51 VOCs ¹	8260C	Groundwater	<u>Surrogates</u> 1,2-Dichloroethane-d4 74-132 4-Bromofluorobenzene 77-124 Toluene-d8 80-120	<u>Surrogates:</u> All samples, standards, QC samples	<u>Field Duplicates:</u> RPD ≤30	<u>Field Duplicates:</u> One per 20 groundwater samples
TCL and CP-51 SVOCs ²	8270D	Groundwater	<u>Surrogates</u> 2-Fluorophenol 25-58 Phenol-d5 14-39 2,4,6-Tribromophenol 26-139 Nitrobenzene-d5 51-108 2-Fluorobiphenyl 45-107 Terphenyl-d14 40-148	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤30	Method Blank/LCS/MS/MSD: 1 per preparation batch of 20 or fewer field samples.
TAL Metals (unfiltered)	6010C	Groundwater	<u>Matrix Spikes</u> 75-125% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples
TAL Metals (filtered)	6010C	Groundwater	<u>Matrix Spikes</u> 75-125% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples

¹ Results of analyses for VOCs will include all TCL VOCs and CP-51-listed VOCs. Included on the TCL and CP- 51 list are the 6 NYCRR Part 375-listed VOCs.

² Results of analyses for SVOCs will include all TCL SVOCs and CP-51-listed SVOCs. Included on the TCL and CP-51 list are the 6 NYCRR Part 375-listed SVOCs.

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<p style="text-align: center;">Table 2B Laboratory Data Quality Objectives: Precision and Accuracy: Groundwater Samples</p>						
Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
Mercury (unfiltered)	7470A	Groundwater	<u>Matrix Spikes:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples
Mercury (unfiltered)	7470A	Groundwater	<u>Matrix Spikes:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples
Total Cyanide	SW 846-9012B	Groundwater	<u>Matrix Spikes:</u> 90-110% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples
TCL Pesticides	8081B	Groundwater	<u>Matrix Spikes:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples
TCL Herbicides	8151A	Groundwater	<u>Matrix Spikes:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples
PCBs	8082A	Groundwater	<u>Matrix Spikes:</u> 80-120% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples

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<p style="text-align: center;">Table 2B Laboratory Data Quality Objectives: Precision and Accuracy: Groundwater Samples</p>						
Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
1,4-Dioxane	8270D SIM	Groundwater	<u>Matrix Spikes</u> 70-130% recovery	<u>Matrix Spikes:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates:</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 groundwater samples
PFAS	537 Modified	Groundwater	<u>Extracted Internal Standard (IDA):</u> 25-150 <u>Refer to Table 2B-I below for LCS & MS/MSD.</u>	<u>Extracted Internal Standard (IDA):</u> Every field and QC sample. <u>LCS/MS/MSD:</u> one per extraction batch of no more than 20 samples. LCSD if not enough sample for MS/MSD.	<u>LCS/LCSD or MS/MSD:</u> RPD ≤30	LCS/LCSD or MS/MSD for each batch of no more than 20 field samples.

<p style="text-align: center;">Table 2B-I LCS & MS/MSD Accuracy Control Limits for PFAS</p>			
Analyte	LCS/MS/MSD % R	Analyte	LCS/MS/MSD % R
Perfluorobutanoic acid (PFBA)	78 - 138	Perfluorononanoic acid (PFNA)	77 - 137
Perfluoropentanoic acid (PFPeA)	66 - 136	Perfluorodecanoic acid (PFDA)	74 - 134
Perfluorohexanoic acid (PFHxA)	76 - 136	Perfluoroundecanoic acid (PFUnA)	68 - 128
Perfluoroheptanoic acid (PFHpA)	78 - 138	Perfluorododecanoic acid (PFDoA)	72 - 132
Perfluorooctanoic acid (PFOA)	70 - 130	Perfluorotridecanoic acid (PFTriA)	56 - 163
Perfluorotetradecanoic acid (PFTeA)	63 - 123	Perfluorodecanesulfonic acid (PFDS)	75 - 135
Perfluorobutanesulfonic acid (PFBS)	79 - 139	Perfluorooctane sulfonamide (FOSA)	82 - 142
Perfluorohexanesulfonic acid (PFHxS)	77 - 137	N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)	79 - 139

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Perfluoroheptanesulfonic acid (PFHpS)	83 - 143	N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)	77 - 137
Perfluorooctanesulfonic acid (PFOS)	74 - 134	1H,1H,2H,2H-perfluorooctane sulfonate (6:2 FTS)	82 - 142
		1H,1H,2H,2H-perfluorodecane sulfonate (8:2 FTS)	80 - 140

Table 2C Laboratory Data Quality Objectives: Precision and Accuracy: Soil Vapor Samples						
Parameter	Method	Matrix	Accuracy Control Limits	Accuracy Frequency Requirements	Precision (RPD) Control Limits	Precision Frequency Requirements
VOCs ¹	TO-15	Soil Vapor	LCS limits vary by analyte (see analytical SOP BR-AT-004)	Each batch or every 20 samples, whichever is less.	N/A	N/A
N/A – Not applicable ¹ Select list of 26 VOCs for analysis includes benzene, carbon tetrachloride, chlorobenzene, chloroethane, chloromethane, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,2-dichloropropane, ethylbenzene, methyl tert-butyl ether, methylene chloride, naphthalene, tetrachloroethene (PCE), toluene, 1,1,1-trichloroethane, trichloroethene (TCE), 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, vinyl chloride, m,p-xylenes, and o-xylene. ² Refer to SOP BR-AT-004, provided in Attachment A.						

Project Goals

The principal objectives of the Remedial Investigation (RI) are to complete the characterization of soil, groundwater, and soil vapor at the Site and confirm groundwater flow direction. The data obtained during the implementation of the RI will be utilized to develop remedial action decisions.

Project Scope

In order to assess soil, groundwater, and soil vapor at the Site, the scope of work includes the advancement of soil borings; installation of temporary soil vapor probes and permanent groundwater monitoring wells; and the collection and laboratory analysis of soil vapor, soil, and groundwater samples.

Select soil and groundwater samples will be analyzed for TCL and NYSDEC CP-51-listed VOCs; TCL and NYSDEC CP-51-listed SVOCs; TAL metals and cyanide, TCL pesticides, TCL herbicides, PCBs and PFAS. Groundwater samples will also be analyzed for 1,4-dioxane (included as SVOC). Soil vapor and indoor air samples will be analyzed for VOCs.

Sampling Plan

Environmental sampling will include soil, groundwater, and soil vapor. Soil samples will be collected using disposable sampling equipment. Groundwater samples will be collected from permanent monitoring wells using peristaltic pumps and new dedicated high density polyethylene (HDPE) tubing. Soil vapor samples will be collected from temporary soil vapor probes using dedicated sampling equipment.

Soil Sampling

Soil samples will be collected in 4- or 5-foot long 2-inch diameter macrocore samplers lined with acetate sleeves. With the exception of soil collected for VOC analysis, the samples will be collected with a disposable scoop and placed in the sample bottles. EnCore® samplers will be used to collect soil samples for VOC analysis. Samplers will wear phthalate-free gloves such as nitrile (no latex will be used). Only clean instruments will be allowed to touch the sample.

Groundwater Sampling

Groundwater samples will be collected from two-inch diameter permanent wells installed on the Site. Groundwater from each well will be purged via a peristaltic pump equipped with HDPE tubing until parameters have stabilized in accordance with USEPA Low-Stress (Low-Flow) sampling procedures. A turbidity level of 50 Nephelometric Turbidity Units (NTUs) or less is the well purging goal, but not an absolute value before sampling. Other field parameters including temperature, conductivity, pH, and dissolved oxygen (DO) will also be monitored. As practical, all field measurements will be taken from the flow-through cell and will be recorded during and after purging, and before sampling. Field parameters should generally be within ± 10 percent for three consecutive readings prior to sampling.

A minimum of three well volumes will be purged prior to sample collection. Ideally, pumping rates will be maintained between 100 and 500 milliliters per minute (ml/min) so that no drawdown of the groundwater level occurs (i.e., pumping rate is less than recharge rate). During purging, the sampler will actively monitor and track the volume of water purged and the field parameter readings. Data will be recorded in the field logbook. For example, the sampler will record the running total volume purged from each well and note the readings for the corresponding field parameters.

Once groundwater conditions have stabilized and groundwater levels have recovered, samples will be collected. Sampling will be performed with the pump intake at the same location used for purging. Pumping rates for withdrawing the samples will be similar to those followed for well purging.

The samples will be collected in sample bottles (pre-preserved, if appropriate), placed in chilled coolers and removed from light immediately after collection. All bottles will be filled to avoid cascading and aeration of the samples, the goal being to minimize any precipitation of colloidal matter.

Due to the pervasive nature of PFAS in various substances routinely used during sampling and the need to mitigate potential cross contamination or sampling bias to ensure representative data are collected, special care should be taken when sampling for PFAS. When sampling for PFAS in groundwater, specific modifications, in accordance with TRC's Standard Operating (SOP) for Groundwater Sampling dated November 2016, will be implemented. TRC's SOP for Groundwater Sampling is provided as Attachment A.

Sub-Slab Vapor Sampling

Sub-Slab vapor sampling will be conducted in accordance with the NYSDOH "Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006)" and ASTM Standard E 2600-10.

The sub-slab vapor samples will be collected using a jackhammer or direct-drive rig (i.e., Geoprobe) that utilizes drive rods to advance the stainless steel probe to 0 to 2 inches below the bottom of the basement slab, the desired sample depth. In accordance with the NYSDOH vapor intrusion guidance, tracer gas (i.e., helium) will be used at each sub-slab vapor sampling location to ensure that an adequate surface seal has been created.

The temporary vapor probe will then be purged using a photoionization detector (PID) to evacuate one to three volumes of soil vapor. Maximum VOC concentrations will be recorded by the field technician. Each probe will be connected via Teflon tubing to a laboratory-supplied individually certified clean SUMMA canister with an 8-hour flow controller.

The indoor air samples will be collected concurrently with the sub-slab vapor samples utilizing individually certified-clean laboratory-supplied 6-liter SUMMA canisters with 8-hour flow controllers. The indoor air samples will be collected at a height of approximately 3 to 5 feet to simulate a typical breathing zone.

QC Sample Collection

QC samples will include trip blanks for groundwater and field duplicates and equipment blanks for soil and groundwater samples. Refer to Tables 1A-1C for a summary of QC sample preservation and container requirements.

Trip blanks will consist of distilled water (supplied by the laboratory) and will be used to assess the potential for volatile organic compound contamination of groundwater samples due to contaminant migration during sample shipment and storage. Trip blanks will be transported to the Site unopened, stored with the investigative samples, and kept closed until analyzed by the laboratory. Trip blanks will be submitted to the laboratory at a frequency of one per cooler that contains groundwater samples for analysis for VOCs.

Field duplicates are an additional aliquot of the same sample submitted for the same parameters as the original sample. Field duplicates will be used to assess the sampling and analytical reproducibility. Field

duplicates will be collected by alternately filling sample bottles from the source being sampled. Field duplicates will be submitted at a frequency of one per 20 samples for all matrices and all parameters. Refer to Tables 1A-1C for a summary of QC sample preservation and container requirements.

Equipment blanks will consist of distilled water and will be used to check for potential contamination of the equipment, which may cause sample contamination. Equipment blanks will be collected by routing the distilled water through the sampling equipment prior to sample collection. Equipment blanks will be submitted to the laboratory at a frequency of one per 20 samples. Equipment blanks will not be collected with soil vapor samples submitted for laboratory analysis. Refer to Tables 1A-1C for a summary of QC sample preservation and container requirements.

Sample Preservation and Containerization

The analytical laboratory will supply the containers for analytical samples. These containers will be cleaned by the manufacturer to meet or exceed all analyte specifications established in the latest USEPA's Specifications and Guidance for Contaminant-Free Sample Containers. Certificates of analysis are provided with each bottle lot and maintained on file to document conformance to USEPA specifications. Soil and groundwater samples will be placed in chilled coolers immediately after collection.

Equipment Decontamination

Re-usable sampling equipment shall be cleaned between each use in the following manner:

- Wash and scrub with Alconox and water mixture
- Tap water rinse
- Wash and scrub with biodegradable degreaser ("ZEP") if there is oily residue on equipment surface.
- Tap water rinse
- Distilled/deionized water rinse
- Air dry

As noted above, special care should be taken when sampling for PFAS. TRC will implement TRC's SOP ECR-010 Equipment Decontamination for PFAS-specific decontamination protocols. TRC's Equipment Decontamination SOP is provided in Attachment A.

Field Custody Procedures

Sample chain-of-custody and packaging procedures are summarized below. These procedures are intended to ensure that the samples will arrive at the laboratory with the chain-of-custody intact.

- The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.
- All bottles will be identified by the use of sample labels with sample numbers, sampling locations, date/time of sample collection, and type of analysis.
- Sample labels will be completed for each sample using waterproof ink unless prohibited by weather conditions. For example, a logbook notation would explain that a pencil was used to fill out the sample label because the pen would not function in wet weather.

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX A
42-24 ORCHARD STREET SITE
BROOKLYN, NEW YORK 11101

- Samples will be accompanied by a properly completed chain-of-custody form. The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage location. A Chain of Custody Form is provided in Attachment B.
- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and placed in the project files.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by field personnel. The cooler will be strapped shut with strapping tape in at least two locations.
- If the samples are sent by common carrier, the air bill will be used. Air bills will be retained as part of the permanent documentation. Commercial carriers are not required to sign off on the custody forms since the custody forms will be sealed inside the sample cooler and the custody seals will remain intact.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample custodian, and signature of the laboratory sample custodian on chain-of-custody document as receiving the samples and signature of sampler as relinquishing samples.

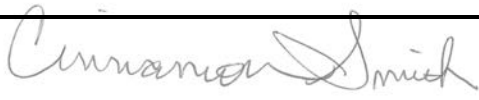

Data Management and Reporting

ASP Category B Laboratory Packages will undergo data validation. A NYSDEC Data Usability Summary Report (DUSR) will be prepared for each laboratory package. Note that waste characterization samples, if collected for laboratory analysis, will not undergo data validation.

ATTACHMENT A

Standard Operating Procedures – TRC and Eurofins/TestAmerica



Title: Groundwater Sampling		Procedure Number: ECR 009	
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Authorization Signatures			
			
Technical Reviewer Cinnamon Smith	Date 11/14/16	ECR Practice Quality Coordinator Elizabeth Denly	Date 11/14/16

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1.0 INTRODUCTION

1.1 Scope & Applicability

This Standard Operating Procedure (SOP) was prepared to provide TRC personnel with general guidance in performing groundwater sampling activities. This SOP details equipment and sampling procedures for low-flow sampling, multi-volume purge sampling and passive diffusion bag sampling from monitoring wells. Various regulatory agencies and project-specific work plans may have specific requirements (e.g., equipment/instrument, flow rate, etc.) that may be applicable and take precedence, depending on the program.

The objective of groundwater sampling is to obtain a representative sample of water from a saturated zone or groundwater-bearing unit (i.e., aquifer) with minimal disturbance of groundwater chemistry. This requires that the sample being collected is representative of groundwater within the formation surrounding the well bore as opposed to stagnant water within the well casing or within the filter pack immediately surrounding the well casing.

1.2 Summary of Method

There are three general approaches to groundwater purging/sampling that can be used to obtain a representative groundwater sample for analysis: 1) the low-flow or micropurge method where the mixing of the stagnant water is minimized using low-flow pumping rates during the collection of the groundwater sample; 2) the multiple well volume removal approach in which the stagnant water is removed from the well and the filter pack prior to sample collection; and 3) the passive sampler procedure where water quality equilibration with the surroundings is achieved through deployment of the passive sampler for a sufficient amount of time prior to sampling.

For low-flow and multiple well volume removal, there are various types of equipment available to perform groundwater sampling. The most common of these are the submersible pump, peristaltic pump, and bailer. However, the equipment selected and the purge method used, if any, will depend on project goals, data quality objectives (DQOs), hydrogeologic conditions, and regulatory requirements. Care should be taken when choosing the sampling procedures and device(s), as some procedures have the potential to affect the representativeness of the sample more than others. For repeated monitoring events, the sampling methodology and operating equipment employed should be consistent to minimize potential variability due to sampling procedures. The type of sampling method utilized is dependent upon site-specific conditions and it is not within the scope of this document to recommend a specific methodology. For specialized sampling programs involving per- and polyfluorinated alkyl substances (PFAS), refer to Attachment D for further details. Information on applicability of sampling methods can be found on Interstate Technology & Regulatory Council (ITRC) and United States Environmental Protection Agency (EPA) websites.

1.3 Equipment

The following equipment is commonly used to collect groundwater samples from a monitoring well. Site-specific conditions may warrant the use of additional equipment or deletion of items from this list.

- Appropriate level of personal protective equipment (PPE) as specified in the site-specific Health and Safety Plan (HASP)
- Electronic water level indicator capable of measuring to 0.01 foot accuracy
- Oil/water interface probe
- Extra batteries for water level/interface probe
- Submersible pump with low-flow capabilities (less than 1 liter/min) constructed of inert materials (e.g., stainless steel and Teflon®), such as a bladder pump (with sufficient quantity of bladders, o-rings, grab plates, etc.)
- Peristaltic pump
- Source of power for use with submersible or peristaltic pump (e.g., 12-volt battery, compressor, generator, compressed gas tanks, etc.)
- Flow controller for use with submersible pump (varies depending on type of pump used)
- Bottom-filling bailer constructed of inert materials (i.e., polyethylene, polyvinyl chloride [PVC], stainless steel or Teflon®)
- Bailer cord or wire (recommended Teflon®-coated, stainless steel cable; bailer wire; or contaminant-free rope with a Teflon®-coated stainless steel leader to connect bailer and rope)
- Tubing (Teflon®, Teflon®-lined polyethylene, or high density polyethylene [HDPE], type dependent upon project objectives)
- Silicone tubing (only used for peristaltic pump head and/or flow-through cell connections)
- Water quality meter(s) capable of measuring parameters, such as pH, temperature, specific conductivity, oxidation-reduction potential (ORP), and dissolved oxygen (DO)
- Flow-through cell
- T-connector
- Turbidity meter
- Passive sampling device (and any device-specific accessories)
 - Passive diffusion bags (PDBs)
 - Tether (stainless steel cable or marine-grade polyethylene rope), well cap, and weights, unless already installed
 - Funnel (Fill kit)
 - PVC cable ties
 - Tool to cut cable ties
 - PVC discharge tubes
 - Tether reel
- Well lock keys
- Bolt cutters

-
- Appropriate tools for equipment and to open well box (e.g., socket wrench, pry bar, etc.)
 - Containers with lids for purge water (i.e., 5-gallon buckets, drums, etc.)
 - Stopwatch or timer
 - Graduated measuring container appropriately sized to measure flow rate
 - Sample bottle labels
 - Laboratory-grade water (can request from lab – for equipment blanks)
 - Chain-of-custody (COC) forms
 - Sample cooler(s)
 - Photoionization detector (PID) or flame ionization detector (FID) for well head monitoring
 - Sample containers (may be supplied by the laboratory depending upon the regulatory program): The proper containers should be determined in conjunction with the analytical laboratory in the planning stages of the project. If not included in sample containers provided by laboratory, sample preservatives will need to be kept with sample containers, and added to sample containers prior to sample collection.
 - Field book and/or Groundwater Field Data Record (multiple copies)
 - Filtration equipment
 - In-line filter (0.45 micron [μm]) or as otherwise required by the project-specific work plan.
 - Bubble wrap/Bubble wrap bags
 - Lint-free, non-abrasive, disposable towels (e.g., Kimwipes®)
 - Indelible marking pens
 - Plastic bags (e.g., Ziploc®)
 - Ice
 - Teflon® tape
 - Plastic sheeting or large trash bags which can be cut open
 - Umbrella, tent, or equivalent for shading equipment (particularly the flow-through cell) from sunlight or blocking rain
 - Equipment decontamination supplies
 - Container for bailing water out of water-logged road boxes or well vaults
 - Map of well locations and well construction data
 - Copy of field notes from previous sampling event for reference
 - Project-specific work plan

1.4 Definitions

Bailer	A cylindrical device suspended from a rope or cable, which is used to remove water, non-aqueous phase liquid (NAPL), sediment or other materials from a well or open borehole. Usually equipped with some type of check valve at the base to allow water, NAPL, and/or sediment to enter the bailer and be retained as it is lifted to the surface. A bailer may be made in varying diameters; however a bailer that fits in a two-inch well is the most common. In some instances a < 1-inch diameter bailer (a.k.a. pencil bailer) is used for small diameter wells.
Borehole	A hole drilled into the soil or bedrock using a drill rig or similar equipment.
Dense Non-aqueous Phase Liquid (DNAPL)	Separate-phase product that is denser than water and, therefore, sinks to the bottom of the water column.
Depth To Water (DTW)	The distance to the groundwater surface from an established measuring point.
Drawdown	The response to purging/pumping a well resulting in the lowering of groundwater within the water column in the well or in a water-bearing zone.
FID	An instrument that uses a flame to break down volatile organic compounds (VOCs) into ions that can be measured.
Flow-Through Cell	The container used to immerse the multi-parameter probes in well purge water during pre-sampling well purging. The flow-through cell is usually made of transparent acrylic and is connected to the end of the discharge tubing creating an in-line, sealed container in which purge water circulates around the measurement probes. The discharge from the pump prior to the flow-through cell may be fitted with a check valve or T-connector for collection of water for turbidity measurement.
Flush Mount	The type of well completion where the riser terminates at or below grade. Flush-mounted wells are typically completed with a “curb box” which is an “at-grade” enclosure designed to protect the well riser.
Light Non-aqueous Phase Liquid (LNAPL)	Separate-phase product that is less dense than water and therefore floats on the surface of the water.

Monitoring Well	A well made from a PVC pipe, or other appropriate material, with slotted screen installed across or within a saturated zone. A monitoring well is typically constructed with a PVC or stainless steel pipe in unconsolidated deposits and with steel casing in bedrock.
PID	An instrument that uses an ultraviolet light source to break down VOCs into ions that can be measured.
Piezometer	A well made from PVC or metal with a slotted screen installed across or within a saturated zone. Piezometers are primarily installed to monitor changes in the potentiometric surface elevation.
Potentiometric Surface	A surface representing the hydraulic head of groundwater.
Protective Casing	The pipe installed around the well riser that sticks up from the ground (above-grade completions) or is flush with the ground (at-grade completions, e.g., curb box) in order to protect the well integrity. Protective casings are typically constructed of steel or aluminum and usually closeable with a locking cover/hasp to maintain well integrity between sampling events.
Recharge Rate	The rate at which groundwater returns to the water column in the well.
Separate-Phase Product	A liquid that does not easily dissolve in water. Separate-phase product can be more dense (i.e., DNAPL) or less dense (i.e., LNAPL) than water and, therefore, can be found at different depths in the water column.
Static Water Level	Level at which water resides in a well when the water level is at equilibrium with atmospheric pressure.
Well Cover	The cap or lid constructed at the end of the protective casing (above-grade completions) or flush-mounted curb box (ground surface completions) to secure access to the well. Well covers for stick-up wells are often equipped with a hasp to accommodate a padlock. Well covers for flush-mounted road boxes or vaults are opened and closed using a threaded bolt.
Well Filter Pack	A material composed of clean silica sand or sand and gravel of selected grain size and gradation that is placed in the annulus between the screened interval and the borehole wall in a well for the purpose of retaining and stabilizing the formation material.
Well Plug/Expansion Plug	The plug fashioned into a cap placed into the top of the well riser (e.g., J-Plug). Well plugs are usually designed with an expandable gasket that is activated by turning a locking wing nut or removable key latch, closing a snap cap or engaging a magnetic clutch cap to seal the well riser.

Well Riser	Sections of blank (non-slotted) pipe that extend from the well screen to or above the ground surface.
Well Screen	Pipe (typically PVC or stainless steel) used to retain the formation or filter pack materials outside of the well. The pipe has openings/slots of a uniform width, orientation, and spacing. The openings/slots can vary based on formation and filter pack material specifications.

1.5 Health & Safety Considerations

TRC personnel will be on site when implementing this SOP. Therefore, TRC personnel shall follow the site-specific HASP. TRC personnel will use the appropriate level of PPE as defined in the HASP.

The well head should be pre-screened using a PID/FID to avoid inhalation of contaminants venting from the well. If monitoring results indicate sustained elevated concentrations of organic contaminants, the level of PPE may need to be increased in accordance with the HASP or work could be conducted upwind of the well.

When present, special care should be taken to avoid contact with LNAPL or DNAPL. The use of an air monitoring program, as well as the proper PPE designated by the site-specific HASP, can identify and/or mitigate potential health hazards.

Implementing this SOP may require the use of reagents and/or compressed gases for the calibration and operation of field equipment. These substances may be hazardous and TRC personnel must appropriately handle, store, and dispose of them at all times. Skin contact with liquid from preserved sample bottles must be avoided as they may contain strong acids or bases. When filling bottles pre-preserved with acid (e.g., hydrochloric acid, nitric acid, sulfuric acid), vapors may be released and should not be inhaled. Do not allow bottles with acid to be exposed to elevated atmospheric temperatures or sunlight as this will facilitate fumes from the acids.

1.6 Cautions and Potential Problems

The following sections highlight issues that may be encountered and should be discussed with the Project Manager prior to mobilization into the field. Special care should be taken when sampling for PFAS. Please refer to Attachment D for details.

1.6.1 Pre-Sampling Issues

- (a) Selection of equipment for groundwater sampling should consider multiple factors, including: DTW, well specifications (e.g., depth and length of well screen intervals), desired flow rate, possible weather conditions, type and concentration of contaminant(s), and remoteness/accessibility to the site. The benefits and limits of each type of groundwater sampling equipment should be fully reviewed during project planning or prior to mobilization if the project-specific work plan does not identify the required equipment. For example, peristaltic pumps are incapable of withdrawing water in wells in which the depth to water is greater than approximately 20-25 feet below ground surface (bgs).

- (b) If the screen or open borehole is greater than 10 feet in length, consult the project-specific work plans for the target sampling interval. Generally, pumps are either placed in the middle of the saturated zone if the water level is below the top of the screen or in the middle of the screen interval if the water level is above the top of the screen.
- (c) The need for redevelopment of the monitoring wells should be evaluated periodically in accordance with the project-specific requirements. This is assessed by comparing the measured total depth of the well with the constructed depth. If the measured depth is less than the constructed depth, this may indicate siltation of the well and/or the presence of an obstruction in the well. If it is determined that redevelopment is necessary, it should be performed in accordance with RMD SOP 006, *Well Development*. The time necessary for a well to restabilize after redevelopment will be determined on a project-specific basis and may depend on regulatory requirements.
- (d) During the total well depth measurement, there is the potential for sediment, if present at the bottom of the well, to be disturbed, thereby increasing the turbidity of the groundwater. Therefore, the total well depth measurement should be collected the day prior to collecting groundwater samples, if possible.
- (e) Use caution if using compressed gas cylinders (e.g., nitrogen, carbon dioxide) for purging/sampling of groundwater. Check for leaks around regulator connections by spraying soapy water on the connections. If a leak is discovered, the connection to the regulator should be disassembled, wrapped with Teflon® tape, and reconnected to the cylinder. If the leak continues, the regulator should be replaced. It should be noted that Department of Transportation (DOT) regulations apply to the transportation and handling of compressed gas cylinders (see 49 Code of Federal Regulations [CFR] 171). Never transport cylinders with the regulator attached. Replace the cylinder valve cover on the compressed gas cylinder before transport.
- (f) All field personnel must be made aware of the water level measurement reference point being used for each well at a site (i.e., must be clearly marked) in order to ensure collection of comparable data between events.
- (g) Bolt cutters may be necessary to remove rusted locks. Dipping rusted locks in a soapy solution may help with opening difficult locks. Oils and other products containing VOCs (e.g., WD-40) should not be used on locks as these compounds may cause contamination of water samples collected at the well. Replace cut locks and note in the field book.
- (h) Prior to accessing the well, physical conditions around the well head should be assessed for situations that might result in cross-contamination or the introduction of foreign material/debris into the well. For example, flush-mounted wells may have water or road sand/salt/debris inside the curb box. Rodents and insects (e.g., bees, wasps) have been known to construct nests within the protective casing of a well. If bees, wasps, or other insects are encountered, insecticides should be used with caution as the chemicals may cause contamination of water samples collected at the well. If water or foreign material is introduced into the well, the Project Manager should be immediately notified.

1.6.2 General Purging and Sampling Issues

- (a) Prior to installation of a submersible pump into a well, ensure that the tubing is properly sealed to the pump to avoid losing the pump down the well and to prevent escape of air or water from the pump, which could result in poor pump performance and the aeration of the well water. Do not do this by tugging on tubing. Never lower pumps into the well using only tubing; instead a security line attached to the pump is required to prevent potentially losing the pump down the well.
- (b) A submersible pump should not be lowered to the bottom of the well to avoid stirring up any sediment at the bottom of the well and prevent getting the pump stuck (fine sediment accumulation in the bottom of the well can create a strong suction with a flat bottom pump such as a bladder pump, which may require jetting to retrieve the pump).
- (c) Start with the lowest pumping rate possible and increase until a sustainable rate is reached. Avoid high pumping rates (> 1 liter/min), as this could lead to damage of the well filter pack, if present. Where practical and/or possible, refer to previous sampling events to establish consistent flow rates.
- (d) Some regulatory agencies may have concern about the use of peristaltic pumps when sampling for VOCs due to the potential for loss of VOCs during sampling and alteration of other water quality parameters such as pH and alkalinity. Samplers should review the requirements in the project-specific work plan and/or regulatory guidelines prior to performing the work. Explicit approval to use a peristaltic pump for the collection of VOCs may be required by the governing regulatory agency. An option may be to use the “soda straw” method to collect the VOC sample which does not allow the water to go through the pump head:
 - (1) After purging the well with the peristaltic pump, collect all fractions except VOCs from the outlet side of the pump (i.e., VOCs will be collected last instead of first).
 - (2) Turn the pump off.
 - (3) Change into clean gloves.
 - (4) Disconnect the tubing coming out of the well from the inlet side of the pump and immediately put a finger over the end of this tubing to prevent water from draining out of the tubing.
 - (5) Retrieve tubing from the well, coiling it in one hand as it is being retrieved (maintain finger over end of tubing).
 - (6) Open VOC vials. Briefly remove finger from end of tubing to allow water to flow into vial. Replace finger on end of tubing to stop flow. Do this for remaining VOC vials.
- (e) In the event that a well cannot be purged and sampled with a pump, the alternative to pumping may be the use of a bottom-filling bailer. The applicable regulatory agency requirements and the Project Manager should be consulted if in doubt about the appropriateness of using a bailer at a site or during a particular sampling event.
- (f) During purging and sampling, the tubing should remain filled with water to minimize possible changes in water chemistry due to contact with the atmosphere. All flow-through cells should be shaded from direct sunlight to minimize the potential for off-gassing and temperature fluctuations.

- (g) Ensure monitoring instruments (i.e., multi-parameter water quality instrument, turbidity meter, water level measuring device) are maintained in good condition and properly calibrated to ensure accurate readings. Be sure to have appropriate-sized extra batteries on hand.
- (h) Adverse weather conditions may present challenges that need to be dealt with on a case-by-case basis. For example, air temperatures below 32°F may cause ice formation in the tubing, flow-through cell, and on the sampling equipment, or heavy rain could cause standing water issues with flush-mounted wells. Heavy rain can also impact electronic sampling equipment; preventative measures should be taken to keep electronic equipment dry.
- (i) Observe and avoid any uncontrolled ambient/surrounding air conditions that could affect analytical results (e.g., truck/vehicle exhaust nearby, industrial building vents). Always ensure that vehicles are turned off during sampling to avoid introducing vehicle exhaust into the sample. If uncontrolled ambient/surrounding air conditions cannot be avoided, contact the Project Manager for further instruction; collection of a field blank sample may be warranted in this situation.
- (j) Procedures should be established to minimize potential cross-contamination. For example:
 - Wrap monitoring and sampling equipment with protective material (e.g., aluminum foil, polyethylene sheeting, Ziploc® bags) after decontamination and between sampling locations to minimize the potential for cross-contamination between well purging events at different locations.
 - Use dedicated or disposable sampling equipment or new tubing at each sampling point when appropriate to minimize the need for decontamination.
 - Protect sampling equipment and/or the open well head from blowing soil and dust by covering with plastic sheeting as needed.
 - If a bailer and rope are used to purge and/or sample the well, then there is the possibility of contamination from the rope used to lower the bailer. New or dedicated rope should be used when appropriate. Alternatively, a decontaminated, Teflon®-coated stainless steel leader can be attached between the rope and the bailer. The leader acts as an extension to the rope and allows for the top of the bailer to enter the water column without immediately placing the rope into the water. It is important to keep the rope clean and not allow contact with the ground surface during bailing.
- (k) Disposal of the groundwater collected during purging must be performed in accordance with all applicable regulations and the project-specific work plan.
- (l) Clear tape should not be used to cover labels on containers used for certain analyses (e.g., 40-mL vials for VOC analysis) due to potential interference with analytical equipment.
- (m) In cases where it is difficult to obtain sufficient sample volume for multiple analytical fractions as well as required quality control (QC) analyses (e.g., field duplicates, matrix spike/matrix spike duplicate [MS/MSD] analyses), discuss this situation with the Project Manager and laboratory prior to sample collection. Laboratories can often “make do” with less volume, especially for inorganic parameters, or increase the reporting limit proportional to the sample volume obtained.

1.7 Personnel Qualifications

Since this SOP will be implemented at sites or in work areas that entail potential exposure to toxic chemicals or hazardous environments, all TRC personnel must be adequately trained. Project- and client-specific training requirements for samplers and other personnel on site should be developed in project planning documents, such as the sampling plan or project-specific work plan. These requirements may include:

- OSHA 40-hour Health and Safety Training for Hazardous Waste Operations and Emergency Response (HAZWOPER) workers
- 8-hour annual HAZWOPER refresher training.

2.0 PROCEDURES

Procedures for collecting groundwater samples from monitoring wells are described below. The project-specific work plan should also be consulted for specific details regarding sampling.

Sampling should always begin at the monitoring well with the least contaminated groundwater and systematically proceed to the well with the most contaminated groundwater, if possible.

2.1 Pre-sampling Activities

- (a) It should be determined if there is the requirement to determine static water level measurements on all wells at the site prior to sampling, regardless if the well is being sampled.
- (b) Prior to field activities, review historical groundwater sampling logs (if available) to maintain consistency for the current sampling event (e.g., equipment type, pump intake depth setting, flow rate, etc.)
- (c) Organize monitoring, purging, and sampling equipment taking care not to allow cross-contamination. This can be accomplished by laying new polyethylene sheeting near the well or using new buckets, etc.
- (d) Calibrate (or perform a calibration check on) all field monitoring equipment on the same day before collecting groundwater samples. Refer to TRC SOPs and manufacturer's equipment calibration instructions. A calibration check may also be required during or at the end of each sampling day. Consult the project-specific work plan.
- (e) Unlock the well cover on the well.
- (f) Record the sample location, time, and date in the field book and/or on the Groundwater Field Data Record.
- (g) On the Groundwater Field Data Record, note the physical condition of the well, including damage, deterioration, and signs of tampering, if any. Collect photographic documentation of serious damage to present to the Project Manager.

- (h) Open the well cap and expansion plug, and stay upwind of and not directly over the well. Note any unusual odors, sounds, or difficulties in opening the well and, if required, measure the organic vapor reading at the rim of the well with a suitable organic vapor screening device (e.g., PID or FID), and record the reading in the field book and/or on the Groundwater Field Data Record. If pressure or vacuum is noted or suspected in the well, allow sufficient time for the water level elevation in the well to equilibrate.
- (i) Gently lower a clean, decontaminated water level measuring device into the well to determine the static water level. If appropriate for site conditions, check for the presence of LNAPL or DNAPL using an oil/water interface probe (refer to ECR SOP 004, *Water Level and Product Measurements*). If LNAPL or DNAPL is detected, contact the Project Manager before proceeding with purging and sampling activities. Record the information on depth to groundwater to the nearest 0.01 feet, depth to LNAPL or DNAPL, and/or thickness of NAPL in the field book and/or the Groundwater Field Data Record. Refer to ECR SOP 004, *Water Level and Product Measurements*, for proper procedures in performing these measurements.
- (j) If required in the project-specific work plan, measure the depth to the bottom of the well to assist in calculating the well volume of the well. If possible, avoid making total well depth measurements on the same day as sampling due to the tendency to disturb sediment during this measurement. If NAPL is suspected, use a decontaminated oil/water interface probe. If the measured depth is less than the constructed depth, this may indicate that the well needs to be redeveloped (see RMD SOP 006, *Well Development*). Consult the project-specific work plan or Project Manager for further instructions.

2.2 Groundwater Purging Activities

Purging is conducted to ensure that representative groundwater is obtained from the water-bearing unit for analysis. The multiple-volume or low-flow purging approach may be used to remove water from the well and monitor the water in order to determine when a well has been adequately purged (i.e., stabilized); at a minimum, the pH, specific conductance and temperature of the groundwater removed during purging should be monitored and recorded in the field notes. Other parameters may be required in some regulatory jurisdictions (e.g., turbidity). Additionally, the purge volume should be monitored and recorded. In some instances, such as when monitoring at solid waste disposal facilities, simply removing an adequate volume of water (e.g., three well volumes) may be suitable for adequate purging, and sampling can commence. Check with the project-specific work plan and appropriate regulatory guidance to determine any specific purging requirements.

If the well has been previously sampled consistent with this SOP, then the prior purging strategy (e.g., method, pump intake depth and the flow rates) should be followed during subsequent sampling events to maintain consistency and minimize potential variability due to the sampling procedure.

2.2.1 Multiple-Volume Purging Approach

The multiple-volume purging approach is typically performed using bailers or submersible or peristaltic pumps. In the multiple-volume purging approach, there are two measurements used to determine adequate purge volume removal prior to sample collection: 1) purge volume and 2) field parameter stabilization. The field parameters should be recorded at regular volumetric

intervals. There are no set criteria for establishing how many total sets of measurements are adequate to document stability of parameters. If the calculated purge volume is small, the measurements should be taken frequently enough (e.g., every 3 to 5 minutes) to provide a sufficient number of measurements to evaluate stability. If the purge volume is large, measurements taken every 15 minutes may be sufficient.

Purge Volume

Prior to purging a well, the amount of water inside the well riser and well screen (i.e., water column) should be determined, if possible. To do this, the diameter of the well should be determined and the water level and total depth of the well should be measured and recorded. The specific methodology for obtaining these measurements is included in SOP 004 *Water Level and Product Measurements*.

Once this information is known, the well volume can be calculated using Equation 1:

$$\text{Well Volume (V)} = \pi r^2 h (\text{cf})$$

Equation 1

where:

π = pi (3.14)

r = radius of well in feet (ft)

h = height of the water column in ft. [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]

cf = conversion factor in gallons per cubic foot (gal/ft^3) = 7.48 gal/ft^3 .

The volume in gallons/linear foot (gal/ft) and liters/linear foot (L/ft) for common-size wells are as follows:

Well Inside Diameter (inches)	Volume (gal/ft)	Volume (L/ft)
1	0.0408	0.1529
2	0.1631	0.6174
3	0.3670	1.3892
4	0.6524	2.4696
6	1.4680	5.5570

If the volumes for the common-size wells above are utilized, Equation 1 is modified as follows:

$$\text{Well volume} = (h)(f)$$

Equation 2

where:

h = height of water column (feet)

f = the volume in gal/ft or L/ft

For volumetric purging, an adequate purge is typically achieved when 3 to 5 well volumes have been removed. The field notes should reflect the single-well volume calculations or determinations according to one of the above methods and a reference to the appropriate multiplication of that volume, (i.e., a minimum of 3 well volumes) clearly identified as a purge volume goal.

For volumetric purging, it is suggested that field readings are collected every ½ well/well screen volume after an initial 1 to ½ well volumes are purged. The volume removed between readings can be adjusted as well-specific information is developed.

If removing a specified volume of water (e.g., 3 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume. In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection. If, after 3 well volumes have been removed, the field parameters have not stabilized (see discussion in Section 2.2.3), additional well volumes (up to a total of 5 well volumes), should be removed. If the parameters have not stabilized within five well volumes, it is at the discretion of the Project Manager whether or not to collect a sample or to continue purging. If, after 5 well volumes, pH and conductivity have stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible with respect to turbidity. The conditions of sampling should be noted in the field book.

2.2.2 Low-flow Purging Approach

The low-flow purging approach is typically performed using peristaltic pumps or submersible pumps. Low-flow purging (also referred to as low-stress purging, low-volume purging, or Micropurging®) is a method of well purging/sampling that minimizes the volume of water withdrawn from a well in obtaining a representative sample. The term low-flow refers to the low velocity with which water enters the pump intake during purging and sampling. The objective is to draw representative saturated zone water through the well screen to the pump intake while avoiding disturbance of the stagnant water above the well screen through minimizing drawdown of the water column in the well. To achieve this, the flow rate should be adjusted to less than 1 L/min (usually, this will be a rate less than 500 ml/min and may be as low as 100 ml/min). Once drawdown stabilizes, the sampled water is isolated from the stagnant water in the well casing, thus eliminating the need for its removal. This sampling method is based on the principle that water within the screened zone passes through continuously and does not mix with water above the screen. Water entering the pump can be considered representative of water in the formation after drawdown and indicator parameters have stabilized.

When performing low-flow purging and sampling, it is recommended that the pump intake be set in the center of the well screen interval (or center of the water column within the well screen if the water level is below the top of the well screen) to help prevent disturbance of any sediment at the bottom of the well. If known, the pump can be placed adjacent to the areas with the highest hydraulic conductivity or highest level of contaminants. Dedicated pumps can be utilized to minimize disturbance of the water column. Subsequent sampling events should duplicate as closely as possible the pump intake depth and the stabilized flow rate from the previous events.

To begin purging, the pump should be started at the lowest pressure/power flow rate setting (e.g., 100 mL/min) and then slowly increased until water begins discharging. Monitor the water level and slowly adjust the pump speed until there is little or no drawdown or drawdown has stabilized. The pump pressure/power may need to be increased for discharge to occur.

The stabilization of drawdown should be documented. Measure and record the flow rate and water level every 3 to 5 minutes during purging. The flow rate should be reduced if drawdown is greater than 0.3 feet over three consecutive 3 to 5 minute interval readings. Note any flow rate

adjustments on the Groundwater Field Data Record. Once an appropriate purge rate has been achieved, record this information, continue purging until water quality indicator parameters have stabilized (see Section 2.2.3), and then sample the well.

Attempts should be made to avoid pumping a well dry. If drawdown cannot be maintained at less than 0.3 feet and the falling water level is approaching the top of the screened interval (or the top of the pump for sampling that began with the water level below the top of the screen), perform the following steps:

1. Reduce the flow rate, or turn the pump off and allow for recovery. (The pump must have a check valve to prevent backflow if it is shut off).
2. Begin pumping again at a lower flow rate.
3. If water draws down to the top of the screened interval again (or the top of the pump for sampling that began with the water level below the top of the screen), turn the pump off and allow for recovery.
4. If two tubing volumes (including volume of water in the pump and flow-through cell) have been removed during purging, sampling can proceed the next time the pump is turned on without waiting for indicator field parameters to stabilize. The project-specific work plan or Project Manager should be consulted for guidance.
5. If this procedure is used, this should be recorded in the field book and/or on the Groundwater Field Data Record.

2.2.3 Field Parameter Stabilization During Purging

Stabilization criteria may depend on project objectives or regulatory-specific requirements. Refer to Appendix A for some of the regulatory-specific requirements for field parameter stabilization. Generally, an adequate purge with respect to the ground water chemistry is achieved when, stability for at least three consecutive measurements is as follows:

- pH \pm 0.1 standard unit (SU)
- specific conductance within 3%
- turbidity within 10% for values greater than 5 nephelometric turbidity units (NTUs). If three turbidity readings are less than 5 NTUs, the values are considered as stabilized

Other parameters, such as DO, may also be used as a stabilization parameter. Typical stabilization goals for DO are within 0.2 mg/L or 10% saturation, whichever is greater. DO measurements should be conducted using either a flow-through cell or an over-topping cell to minimize or reduce potential oxygenation of the sample.

Because groundwater temperature is generally not very sensitive in distinguishing between stagnant casing water and formation water and is subject to rapid changes during purging, its usefulness is subject to question for the purpose of determining parameter stability. Even if temperature is not used to determine stability during well purging, it is still advisable to record the sample temperature, along with the other groundwater chemistry parameters, during well purging, as it may be needed to interpret other parameter results.

ORP is not always used as a stabilization parameter since it may also be subject to rapid changes during the purging process; however, it may be measured and recorded during well purging.

2.2.4 Special Considerations During Purging

Wells Purged Dry/Purge Adequacy

For wells with slow groundwater recovery, attempts should be made to avoid purging the well dry. This may be accomplished by slowing the purge rate. As water enters a well that has been purged dry, the water may cascade down the sand pack and/or the well screen, potentially stripping VOCs that may be present and/or potentially mobilizing soil fines into the re-accumulating water column.

However, even with slower purge rates, in some situations, a well may be pumped or bailed dry (evacuated) during the purging process. In these situations, evacuation generally constitutes an adequate purge and the well may be sampled following sufficient recovery (enough volume to allow filling of all sample containers). **It is not necessary that the well be evacuated three times before it is sampled.** Purging parameters should be measured and recorded during sample collection to serve as the measurements of record for the sampling event.

It is particularly important that wells be sampled as soon as possible after purging to maintain sample representativeness. If adequate volume is available upon completion of purging, the well should be sampled immediately. If not, sampling should occur as soon as adequate volume has recovered. If possible, sampling of wells that have a slow recovery should be scheduled so that they can be purged and sampled in the same day after adequate volume has recovered. Wells of this type should, unless it is unavoidable, not be purged at the end of one day and sampled the following day.

Temporary Monitoring Wells

Procedures used to purge temporary groundwater monitoring wells may differ from permanent wells, because temporary wells are installed with different DQOs for immediate sample acquisition. Wells of this type may include standard well screens and risers placed in boreholes created by hand augering, power augering, or by drilling. Alternatively, they may consist of a rigid rod and screen that is pushed, driven, or hammered into place to the desired sampling interval, such as a direct push Wellpoint®, a Geoprobe® Screen Point 15/16 sampler, or a Hydropunch® sampler.

Purging to address stagnant water may not necessarily apply to temporary wells, because stagnant water is not typically present. It is important to note, however, that the longer a temporary well is in place and not sampled, the more stagnant the water column may become, and the more appropriate it may be to apply, to the extent possible, standard permanent monitoring well purging criteria.

In cases where the temporary well is to be sampled immediately after installation, purging is conducted primarily to mitigate the impacts of installation. In most cases, temporary well installation procedures disturb the existing saturated conditions, resulting primarily in increased turbidity. Therefore, the goal of purging, if conducted, may be to reduce the turbidity and remove the volume of water in the area directly impacted by the installation procedure. Low turbidity conditions in these types of wells that are completed within the limit of suction are typically and

routinely achieved by the use of low-flow/low-stress purging techniques using variable-speed peristaltic pumps.

2.2.5 Equipment Considerations for Purging

Monitoring well purging is accomplished by using in-place plumbing and dedicated pumps or by using portable pumps/equipment when dedicated systems are not present. The pump of choice is usually a function of the purging approach (e.g., multiple-volume vs. low-flow), well diameter, the DTW, the total depth of the well, the amount of water that is to be removed during purging, the specific analytical testing program for the well, and the equipment previously used during purging and sampling of the well. A peristaltic pump is appropriate for purging whenever the head difference between the sampling location and the water level is less than the limit of suction (approximately 25' to 30') and the volume to be removed is reasonably small. For wells where the water level is below the limit of suction, and/or where there is a large volume of water to be purged, the variable-speed electric submersible pump or adjustable-rate bladder pumps would be appropriate. Bailers may also be used for purging in appropriate situations (e.g., shallow wells with small purge volumes); bailers are not suitable for low-flow purging.

The following subsections describe well evacuation devices that are most commonly used. Other devices are available but are not discussed in this SOP due to their limited use. Site-specific operating procedures should be developed in the case that an uncommon purge device is used.

2.2.5.1 Purging with a Suction Pump

There are many different types of suction pumps. They commonly include: centrifugal, peristaltic and diaphragm. Diaphragm pumps can be used for well evacuation at a fast pumping rate and sampling at a low pumping rate. The peristaltic pump is a low-volume pump that incorporates a roller to squeeze flexible tubing, thereby creating suction. This tubing can be dedicated to a well for re-use or discarded. It is recommended that 1/4 inch or 3/8 inch (inner diameter) tubing be used to help ensure that the sample tubing remains filled with water and to prevent water from being aerated as it flows through the tubing. Purging procedures are as follows.

- (a) Determine the volume of water to be purged as described in Section 2.2.1 or follow the low-flow approach described in Section 2.2.2 (applicable to peristaltic pumps only).
- (b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of pumps, tubing or other purging/sampling equipment with foreign materials.
- (c) Assemble the pump, tubing and power source, if necessary, in accordance with manufacturer's specifications.
- (d) Ensure that the pump tubing is set at the pre-determined pump intake depth.
- (e) Connect the discharge line from the pump to the flow-through cell for parameter measurements. Use a T-connection or valve prior to the flow-through cell to allow for collection of water for turbidity measurements. Direct the discharge line from the flow-through cell to a 5-gallon bucket (or equivalent) to contain the purge water for proper disposal. Verify the end of the tubing is not submerged in the purge bucket. Manage purge water as specified in the project-specific work plan.

- (f) Do not allow the pump to run dry. If the pumping rate exceeds the well recharge rate, adjust the rate accordingly or, if consistent with the purging and sampling objectives, lower the tubing further into the well and continue pumping.
- (g) Using the water quality meter, take an initial reading of the required indicator parameters. All measurements, except turbidity, must be obtained using a transparent flow-through cell unless an unforeseen situation makes this impractical or inadvisable. Initially, turbidity may be elevated. Once turbidity has decreased to a measurable range, begin monitoring indicator parameters at approximately every 3-5 minutes, or as appropriate. Please note that flow-through cell size should be taken into account in conjunction with the flow rate to determine the length of time between water quality parameter readings. At least one flow-through cell volume should be turned over between readings. For example, if the flow through cell size is 500 mL and the flow rate is 100 mL/min, then it would be appropriate to measure water quality parameters every 5 minutes.
- (h) Record the readings on the Groundwater Field Data Record. The monitoring probes must be submerged in water at all times. Record the indicator parameters, along with the water level, as described in Step (g) above. If removing a specified volume of water (e.g., 3-5 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume. In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection. Stabilization criteria are discussed in Section 2.2.3.

Particulate build-up in the flow-through cell may impact indicator parameters. If the cell must be cleaned during pumping operations, continue pumping and disconnect the cell for cleaning, then reconnect and continue monitoring. Record the start and stop times, and describe the cleaning steps in the field book.

If indicator parameter stabilization is required and parameters have not stabilized after 2-hours of purging (or other pre-determined length of time), one of three options may be taken after consultation with the Project Manager:

- 1) continue purging until stabilization is achieved;
- 2) discontinue purging, do not collect any samples, and record in the field book and/or on the Groundwater Field Data Record the stabilization conditions and steps taken to attempt to achieve stabilization; or,
- 3) discontinue purging, collect samples and document attempts to achieve stabilization.

NOTE: If parameters do not stabilize, or turbidity remains greater than 5 NTU within the project-determined time range (EPA recommends up to 2 hours), contact the Project Manager to develop a modified sampling approach.

- (i) Record the volume of water purged on the Groundwater Field Data Record. Record the disposal method used for purge water in the field book.
- (j) Once the required volume of water is removed (typically 3 to 5 well volumes) from the well and/or parameters are stabilized to the satisfaction of the project-specific work plan, proceed to Section 2.3, Post-purging Groundwater Sample Collection.

2.2.5.2 Purging with a Submersible Pump

Submersible pumps generally use one of two types of power supplies, either electric or compressed gas. Electric pumps can be powered by a 12-volt DC rechargeable battery, or a 110-

or 220-volt AC power supply. Those units powered by compressed gas (e.g., bladder pump) normally use a small electric controller that also needs a 12-volt DC battery or 110-volt AC power. They may also utilize compressed gas from bottles. Pumps differ according to the depth and diameter of the monitoring wells and the height of the potentiometric surface/water table (e.g., pressure head). It is recommended that 1/4-inch or 3/8-inch (inner diameter) tubing be used to help ensure that the sample tubing remains filled with water and to prevent water from being aerated as it flows through the tubing. Purging procedures are as follows.

- (a) Determine the volume of water to be purged as described in Section 2.2.1 or follow the low-flow approach described in Section 2.2.2.
- (b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of pumps, tubing or other purging/sampling equipment with foreign materials.
- (c) Assemble the pump, tubing and power source, if necessary, in accordance with manufacturer's specifications. If the pump itself is being lowered into the well, ensure a safety line is attached.
- (d) Non-dedicated purge/sampling vs. dedicated purge/sampling systems.

Dedicated systems: Pump has already been installed. Refer to historical monitoring well information, and record the depth of the pump intake in the field book and/or on the Groundwater Field Data Record.

Non-dedicated systems: Determine the target depth of the pump intake. Note that this may be a historical intake depth; see well construction data or the project-specific work plan. If there is not an established intake depth, the center of the screened interval should be targeted. If the measured water level is lower than the top of the well screen, position the pump intake at the midpoint of the water column. The intake should be generally 1 to 2 feet above the bottom of the well to minimize potential mobilization of any settled sediment, the risk of the pumping suction being broken, or the entrainment of air in the pump tubing and resulting sample. Slowly lower the pump, safety line, and tubing into the well to the pre-determined pump intake depth. The tubing should be cut to the desired length to assist in installing the pump. Measure the depth of the pump intake while lowering the tubing/pump into location. Record the pump intake depth in the field book and/or on the Groundwater Field Data Record. For deeper wells and large diameter wells, two staff members may be necessary to accomplish this task.

- (e) Connect the discharge line from the pump to the flow-through cell for parameter measurements. Use a T-connection or valve prior to the flow-through cell to allow for collection of water for turbidity measurements. Direct the discharge line from the flow-through cell to a 5-gallon bucket (or equivalent) to contain the purge water for proper disposal. Verify the end of the tubing is not submerged in the purge bucket. Manage purge water as specified in the project-specific work plan.
- (f) Measure the flow rate of the pump with a graduated container and stop watch. The pump pressure may need to be increased for discharge to occur. Record the volume of water collected for a period of 1 minute and calculate the flow rate as follows.

$$\text{Flowrate (mL / min)} = \frac{\text{volume collected (mL)}}{1 \text{ minute}}$$

- (g) Measure the water level and record the flow rate and the water level. This should be performed every 3 to 5 minutes during purging. For low-flow purging, the flow rate should be adjusted to result in a rate between 100 to 500 mL/min; however, if drawdown of the well is observed, a slower flow rate may be necessary. If using a bladder pump, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL volatile organic analysis (VOA) vial, if possible.
- (h) Prior to recording the water quality indicator parameters, a minimum of one tubing volume should be purged. Note that this includes the volume of the flow-through cell.
- (i) Proceed to steps (g) through (j) in Section 2.2.5.1.

2.2.5.3 Purging with a Bailer

- (a) Determine the volume of water to be purged as described in Section 2.2.1.
- (b) Take necessary precautions (e.g., laying plastic sheeting around the well) to prevent contamination of tubing or other purging/sampling equipment with foreign materials.
- (c) Use a well-dedicated bailer (i.e., used exclusively for that well only), a decontaminated bailer or an unused, disposable bailer.
- (d) Attach an appropriate length of (a) bailing line, (b) Teflon®-coated bailing wire or (c) rope with Teflon®-coated stainless steel leader to reach the bottom of the well. Secure a knot or series of knots to the top of the bailer. Be sure to have additional length of line to facilitate handling of the bailer at the surface (typically 10 ft).
- (e) Lower the bailer gently into the well until it reaches the water column and fills with water from the bottom. Note: It is recommended that the bailer be lowered into the water to a depth that prevents the water from entering the top of the bailer. This is done to prevent excess turbulence caused by filling from the bottom and the top simultaneously. Controlling the line attached to the bailer as it is lowered into the well is also important to prevent degassing of the water as the bailer impacts the water. In shallow wells, controlling the line is not too difficult; however, for wells of greater depths it is common to utilize a hand-over-hand (windmill) approach using both hands to control longer lengths of line and prevent the loops in the line from tangling with one another. This procedure is simple to learn and saves a good deal of time by preventing tangles. Do not allow the bailing line or rope to become contaminated by surface soil.
- (f) Once the bailer is full of water, gently withdraw the bailer from the well until it comes out of the top of the well. Be sure to control excess line in your hands to prevent the rope and bailer from touching the ground, and then grasp the bailer as it appears at the top of the well.
- (g) Immediately pour the water into a vessel for water quality measurements, and record the measurements in the field book or on the Groundwater Field Data Record (at the project-required frequency). Otherwise, pour water into a 5-gallon bucket or other vessel to track the volume purged. As a general rule, standard 2-inch bailers are able to hold about 1 liter of water when full. This process will have to be repeated several times to complete adequate purging of the well (e.g., three to five well volumes).
- (h) Record the volume of water purged on the Groundwater Field Data Record. Record the disposal method used for purge water in the field book.
- (i) Once the required volume of water is removed (typically 3 to 5 well volumes) from the well and/or parameters are stabilized to the satisfaction of the project-specific work plan, proceed to Section 2.3, Post-purging Groundwater Sample Collection.

2.3 Post-purging Groundwater Sample Collection

- (a) New, disposable gloves should be donned immediately prior to sample collection and should be changed at any point that their cleanliness becomes compromised during sample collection.
- (b) If using a submersible or peristaltic pump, maintain the same flow rate as used during purging. Disconnect the pump tubing from the flow-through cell or sample from the T-connector, if used. Samples must be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. This is critically important to avoid cross-contamination between wells.
- (c) If using bottom-filling bailers,
 - Slowly lower the bailer into the well until it is submerged to the point where water does not enter the top (i.e., bottom-filling).
 - Retrieve the bailer. The first bailer recovered after well purging must be used for sample collection.

2.3.1 Sample Collection Order

Fractions of the groundwater sample should be collected in the following order (i.e., decreasing volatility) unless otherwise specified in the project-specific work plan:

1. VOCs;
2. Semivolatile organic compounds (SVOCs);
3. Other organic parameters;
4. Unfiltered inorganic constituents (e.g., total metals);
5. Filtered inorganic constituents (e.g., dissolved metals); and
6. Other constituents.

During sample collection, allow the water to flow directly down the side of the sample container without allowing the tubing to touch the inside of the sample container or lid in order to minimize aeration and turbulence and maintain sample integrity. The tubing should remain filled with water.

2.3.2 VOC Sample Collection

Collection of VOCs/Volatile Petroleum Hydrocarbons (VPH): Samples for VOCs will be collected first unless they are being collected by the “straw” method described in Section 1.6.2 (d), and the sample vial must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, the vial should be topped off using a minimal amount of sample to re-establish the meniscus. Care should be taken to not flush any preservative out of the vial when topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample re-collected. Note: Extra VOC vials should be obtained prior to the sampling event in case this situation occurs.

Note: When using a bladder pump, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 ml VOA vial, if possible.

When acid preservation is used for the collection of VOCs, the acid must be added to the vials before sample collection. However, in most cases 40-ml VOA vials come pre-preserved. If a pre-preserved vial effervesces upon the addition of sample, the acid preservative can be rinsed out of the vial with sample water and then used to collect the sample. The laboratory should be made aware that the affected sample will not be acid-preserved as this may affect the sample holding time. Note effervescence in the field book for future reference.

2.3.3 Non-VOC Sample Collection

Completely fill the remaining sample containers for all non-VOC analyses.

Preserve the non-VOC samples in accordance with method and project-specific requirements following sample collection if the sample containers are not pre-preserved. (**NOTE:** Pre-preserved vials may be supplied by the laboratory, depending on the program).

2.3.4 Field Filtering

Depending upon project requirements, field filtering may be performed for non-VOC analyses. An in-line filter should be fitted at the end of the discharge tubing and the sample should be collected after the filter. Pre-rinse the in-line filter by allowing a minimum of 0.5 to 1 liter of groundwater from the well to pass through the filter prior to sampling. Ensure the filter is free of air bubbles prior to collecting samples. Preserve the filtered water sample immediately or directly fill pre-preserved containers (if provided). Clearly note “filtered” or “dissolved” on sample label and COC document.

2.4 Groundwater Sample Collection Without Purging (Passive Sampling)

Passive sampling can be defined as the free flow of contaminants from the media being sampled to a receiving phase in a sampling device. Depending upon the sampler, the receiving phase can be a solvent (e.g., water), chemical reagent, or porous adsorbent (e.g., activated carbon). While there are many different types of passive samplers, most have a barrier between the medium being sampled and the receiving phase. The barrier determines the sampling rate that contaminants are collected at a given concentration and can be used to selectively permit or restrict various classes of chemicals from entering the receiving phase.

There are three generic forms of passive (no purge) samplers: thief (grab) samplers, diffusion (equilibrium) samplers, and integrating (kinetic) samplers. However, this SOP focuses on the more commonly used diffusion (equilibrium) samplers.

Passive samplers are deployed down a well to the desired depth within the screened interval or open borehole to obtain a discrete sample without using pumping or a purging technique. Most samplers are able to be stacked to obtain samples at multiple depths. Some samplers can also be used to measure contaminants in groundwater as it enters a surface water body.

Diffusion, or equilibrium, samplers are devices that rely on diffusion of the analytes to reach equilibrium between the sampler fluid and the well water. Samples are time-weighted toward

conditions at the sampling point during the latter portion of the deployment period. The degree of weighting depends on analyte and device-specific diffusion rates. Typically, conditions during only the last few days of sampler deployment are represented. Depending upon the contaminant of concern, equilibration times range from a few days to several weeks. Diffusion samplers are less versatile than grab samplers as they are not generally effective for all chemical classes.

Both the diffusion and integrating samplers depend upon permeation or diffusion through barriers that hold the receiving phase. This diffusion process is chemical and barrier specific. Diffusion samplers are commonly known as PDBs or rigid porous polyethylene (RPP) samplers. PDBs may be used to sample for VOCs, and RPPs may be used to sample for various organic and inorganic constituents. PDBs must be allowed to remain in the well for a sufficient period of time to allow the deionized water in the sampler to come into equilibrium with the constituents in the ambient groundwater.

Some regulatory agencies allow groundwater samples to be collected without purging the well. This may be accomplished by suspending a passive sampler in the well for a period of time appropriate for the type of passive sampler being used. It is important to confirm that the chosen sampler is compatible with the contaminants of concern including all VOCs of interest at the site.

Diffusion passive samplers are used most commonly and the procedure for their use is as follows:

- (a) Passive samplers are deployed at a predetermined depth across the well screen. Typically, the initial sampling event may deploy multiple passive samplers across 5-foot intervals of saturated well screen to observe any potential stratification. Long-term sampling depths typically target a zone of higher concentration, if present.
- (b) New passive samplers are attached via PVC cable ties to a tether (a pre-made marine-grade polyethylene rope or stainless steel cable with a weight at the bottom) that is then suspended within the well. There should be sufficient well screen saturation within the well to completely cover the passive sampler. For VOCs, it is recommended that there should be several feet of groundwater above the top of the PDB.
- (c) The passive sampler should be allowed to equilibrate with groundwater for an appropriate period of time (e.g., at least 2 weeks for PDB samplers). Longer equilibration times may be necessary in lower permeability formations. Once sufficient time for equilibration has passed, the PDB samplers can be retrieved when convenient.
- (d) Raise the passive sampler to the surface using a tether reel. Examine the surface of the passive sampler for evidence of algae, iron, or other coatings, and for tears to the membrane. Note observations in the field book. If tears are present and water is leaking out, the sample is not considered viable. Contact the Project Manager.
- (e) Detach the passive sampler from the tether.
- (f) Remove excess beaded water from the passive sampler with a clean gloved hand, running top to bottom; this is to minimize the contact of beaded water with water in the passive sampler.
- (g) Use a small diameter discharge tube (<0.15 inch diameter to reduce volatilization) and pierce near the bottom, allowing water to smoothly flow into the VOA vial. Tilting the passive

sampler will control the flow rate. The VOA vials must be filled within the first several minutes of passive sampler retrieval. (Note that sample vials should be prepared and opened on a stable surface or holding device such as a foam pack. Decanting sample from passive samplers into containers requires techniques that may require some practice and patience.) Refer to Section 2.3.2 for special circumstances regarding the filling of VOA vials.

- (h) A small amount of water may remain within the passive sampler after filling the VOA vials and can be used for field parameter measurements if required.
- (i) Dispose of the passive sampler after use.

2.5 Post-sampling Activities

- (a) Cease pumping and, if system is non-dedicated, disassemble and decontaminate the purging and sampling equipment. Verify the end of the tubing is not submerged in the purge bucket prior to turning off the pump.
- (b) Dispose of the bailer (if disposable) and/or rope and/or other disposable equipment in accordance with the project-specific work plan, or store the bailer in a plastic bag for transport to the site decontamination area.
- (c) Dispose of the empty passive sampler and/or rope and/or other disposable equipment in accordance with the project-specific work plan, or store the empty passive sampler in a plastic bag for transport to the site decontamination area
- (d) Replace the well cap and well cover on the well and lock the outer casing (if present).
- (e) Label each sample. If the labels are covered with clear tape, ensure this is not performed for VOA vials.
- (f) Place all samples in a cooler with ice.
- (g) Ensure samples are delivered to the laboratory well before the required holding time expires.
- (h) Consult the project-specific work plan to determine if a calibration check is required at the end of the day for the water quality parameters.

3.0 INVESTIGATION-DERIVED WASTE DISPOSAL

Field personnel should discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager.

Each project must consider investigation-derived waste disposal methods and have a plan in place prior to performing the field work. Provisions must be in place as to what will be done with investigation-derived waste. If investigation-derived waste cannot be returned to the site, consider material containment, such as a composite drum, proper labeling, on-site storage by the client, testing for disposal approval of the materials, and ultimately the pickup and disposal of the materials by appropriately licensed vendors.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

The collection of QC samples is dependent upon the DQOs. Project-specific work plans should be consulted to determine the required frequency of QC sample collection.

4.1 *Field Duplicates*

The following procedures should be used for collecting field duplicates of groundwater samples:

- (a) For QC purposes, each duplicate sample will be typically submitted to the laboratory as a “blind” duplicate sample, in that a unique sample identification not tied to the primary sample identification will be assigned to the duplicate (e.g., DUP-01). Standard labeling procedures used for groundwater sampling will be employed. However, a sample collection time will not be included on the sample label or the COC form. The actual source of the duplicate sample will be recorded in the field book and/or on the Groundwater Field Data Record.
- (b) Each duplicate sample will be collected simultaneously with the actual sample by alternately filling sample and duplicate bottles. Following the order of collection specified for each set of containers (VOCs, SVOCs, other organic parameters, unfiltered inorganic constituents, and filtered inorganic constituents), the duplicate sample containers will be alternately filled with groundwater for each parameter.
- (c) All collection and preservation procedures outlined for groundwater sampling will be followed for each duplicate sample.

4.2 *Equipment Blanks*

Equipment blanks include reagent water that is run through the bailer (if not disposable), rope, leader line, decontaminated pump, a representative section of the pump’s tubing, or any other piece of sampling equipment that may have come in contact with the sample. The equipment blanks are collected and preserved in the same sample containers as field samples. If dedicated or disposable systems are used, equipment blanks are not required, although an initial blank could be performed to demonstrate that the dedicated equipment is clean prior to use. If only dedicated tubing is used, the equipment blank will include only the pump in subsequent sampling events. A passive sampler is considered a dedicated device and no equipment blank is required.

Ideally, the reagent water should come from the laboratory and be certified clean. If not certified and/or if not from the laboratory performing the analyses, a separate water blank that has not run through the sampling equipment should be sent to the laboratory for analysis.

4.3 *Trip Blanks*

Trip blanks will be used to check for potential contamination of VOCs via migration during storage and shipping. Trip blanks typically consist of two to three 40 mL VOA vials filled with analyte-free water and preserved with hydrochloric acid (HCl) to pH <2 SU. Trip blank containers are usually supplied pre-filled by the laboratory. Trip blanks are typically submitted to the laboratory at a frequency of one per cooler for coolers that contain samples for VOC and/or VPH analysis. Trip blanks are analyzed by the laboratory for VOCs and/or VPH, depending on field sample analyses.

4.4 MS/MSDs and MS/Duplicates

MSs are an additional analysis of a sample spiked by the laboratory with a subset or all of the target analytes and are used to demonstrate the accuracy of analytical methods for a given matrix. MSDs are an additional analysis of a sample spiked with a subset or all of the target analytes and are also used to demonstrate the accuracy of analytical methods for a given matrix. MS/MSDs also provide a measure of analytical precision for a given matrix. Duplicates are an additional analysis of a sample and are used to demonstrate the precision of analytical methods for a given matrix.

Triplicate volumes of a field sample must be collected in order for the laboratory to have enough volume to perform the MS/MSD analyses for organic parameters. Duplicate volumes of a field sample must be collected in order for the laboratory to have enough volume to perform MS/Duplicate analyses for inorganic parameters. The sample designated for MS/MSD or MS/Duplicate analyses should be noted in the Comments column of the COC document.

4.5 Temperature Blanks

Temperature blanks consist of a sample container filled with non-preserved water (potable or distilled) and typically are included in all coolers that contain samples that require temperature preservation. These may be added to the coolers by the field team if not provided by the laboratory. Temperature blanks must remain inside the coolers on ice during the sampling process.

5.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

Record the sample location, sample identification, and date and time of collection in the field book and/or the Groundwater Field Data Record. The Groundwater Field Data Record (Attachment B) should be used to record the following information:

- Volume of each sample
- Sample identification number
- Sample location (sketch of the sample point)
- Time and date sample was collected
- Personnel performing the task
- Volume of water removed
- Purging time
- Flow rate during purging and sampling
- Weather conditions during sampling
- Field parameters such as water level, pH, temperature, conductivity, turbidity, ORP, and DO
- Sample collection equipment and method used
- Decontamination procedures
- Analytical parameters
- Preservation method and amount of preservative

All sample numbers must be documented on the COC form that accompanies the samples during shipment. Any deviations from the records management procedures specified in the project-specific work plan must be approved by the Project Manager and documented in the field book.

6.0 REFERENCES

Interstate Technology Regulatory Council (ITRC). March 2006. *Technology Overview of Passive Sampler Technologies*.

USEPA. November 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance*. EPA/530-R-93-001. USEPA Office of Solid Waste.

USEPA. April 1996. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA Ground Water Issue. EPA/540-S-95-504. USEPA Office of Solid Waste and Emergency Response.

USEPA. May 2002. *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*. EPA/542-S-02-001. USEPA Office of Solid Waste and Emergency Response.

USEPA. September 2004. Field Sampling Guidance Document #1220: Groundwater Well Sampling. USEPA Region 9 Laboratory Richmond, California.

USEPA, January 19, 2010. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*. USEPA Region 1, Rev. 3.

USEPA. March 6, 2013. *Groundwater Sampling*. SESDPROC-301-R3. USEPA Region 4, Science and Ecosystem Support Division. Athens, Georgia.

USEPA. April 22, 2014. Passive (No Purge) Samples.

http://www.clu-in.org/characterization/technologies/default.focus/sec/Passive_%28no%20purge%29_Samplers/cat/Overview/

7.0 SOP REVISION HISTORY

REVISION NUMBER	REVISION DATE	REASON FOR REVISION
0	AUGUST 2014	NOT APPLICABLE
1	JULY 2016	ADDED ATTACHMENT D TO ACCOMMODATE SOP MODIFICATIONS REQUIRED WHEN SAMPLING FOR PFCs; CHANGED NAMING CONVENTION FOR SOP FROM RMD TO ECR.
2	NOVEMBER 2016	ADDED ADDITIONAL INFORMATION REGARDING PFAS.

Attachment A:


Groundwater Field Parameter Stabilization Criteria for Selected Jurisdictions

Jurisdiction	Information Source	Applicable Stabilization Criteria
USEPA Region 1	<p>Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells; U.S. Environmental Protection Agency Region 1, January 19, 2010.</p> <p>http://www.epa.gov/region1/lab/qa/pdfs/EQASOP-GW001.pdf (for low flow PDF)</p> <p>http://www.epa.gov/region1/lab/qa/qualsys.html (for EPA's Quality System Documents)</p>	<p>pH: ± 0.1 unit</p> <p>Specific Conductance: $\pm 3\%$</p> <p>Temperature: $\pm 3\%$</p> <p>Turbidity: $\pm 10\%$ if > 5 NTUs; if three Turbidity values are < 5 NTU, consider the values as stabilized</p> <p>Dissolved Oxygen: $\pm 10\%$ if > 0.5 mg/L, if three Dissolved Oxygen values are < 0.5 mg/L, consider the values as stabilized</p> <p>Oxidation/Reduction Potential: ± 10 millivolts</p>
USEPA Region 2	Groundwater Sampling Procedure: Low Stress (Low Flow) Purging and Sampling, SOP # SST-7, Revision No. 1, November 2010.	Same as above
USEPA Region 4	<p>USEPA Region 4 SOPs:</p> <p>http://www.epa.gov/region4/sesd/fbqstp/index.html</p> <p>See Chemical Parameter Stabilization Criteria (section 3.2.1.1.2 of Groundwater Sampling SOP, revision 3/6/2013:</p> <p>http://www.epa.gov/region4/sesd/fbqstp/Groundwater-Sampling.pdf</p>	<p>pH: ± 0.1 unit</p> <p>Specific Conductance: $\pm 5\%$</p> <p>Temperature: Not used</p> <p>Turbidity: "Stabilized" (no criteria specified) if > 10 NTUs ; if three Turbidity values are < 10 NTUs, consider the values as stabilized</p> <p>Dissolved Oxygen (optional parameter): ± 0.2 mg/L or $\pm 10\%$ of saturation, whichever is greater</p> <p>Oxidation/Reduction Potential: Not used</p>
USEPA Region 5	<p>Ground Water Forum Issue Paper (May 2002, Yeskis and Zavala)</p> <p>http://www.epa.gov/superfund/remedytech/tsp/download/gw_sampling_guide.pdf</p> <p>A minimum set of parameters would include pH, conductivity, and turbidity or DO.</p> <p>Puls and Barcelona, 1996 (pH, specific conductance, ORP, turbidity)</p> <p>Wilde et al., 1998 (pH, turbidity, DO)</p>	<p>pH: ± 0.1 unit</p> <p>Specific Conductance: $\pm 3\%$</p> <p>Temperature: Not used</p> <p>Turbidity: $\pm 10\%$ if > 10 NTUs</p> <p>Dissolved Oxygen: ± 0.3 mg/L</p> <p>Oxidation/Reduction Potential: ± 10 millivolts</p>
USEPA Region 9	See USEPA Region 1 (above)	
USEPA Region 10	See USEPA Region 5 (above)	
Alabama	<p>Alabama Environmental Investigation and Remediation Guidance (section C.3.1)</p> <p>http://www.adem.state.al.us/MoreInfo/pubs/AEIRGInvestigation.pdf</p>	<p>pH: ± 0.1 unit</p> <p>Specific Conductance: $\pm 10\%$</p> <p>Temperature: "Constant" (no criteria specified)</p> <p>Turbidity: Stabilized (no criteria specified), or < 10 NTUs</p> <p>Dissolved Oxygen: No criteria specified</p> <p>Oxidation/Reduction Potential: No criteria specified</p>

Jurisdiction	Information Source	Applicable Stabilization Criteria
Indiana	<p>Indiana Department of Environmental Management The Micro-Purge Sampling Option http://www.in.gov/idem/files/remediation_tech_guidance_micro-purge.pdf</p> <p>The parameters normally measured for stability (listed in increasing order of sensitivity) are pH, temperature, specific conductivity, oxidation-reduction potential, DO and turbidity. At least one of the last three listed must be used.</p>	<p>pH: ± 0.1 unit Specific Conductance: $\pm 3\%$ Temperature: $\pm 3\%$ Turbidity: $\pm 10\%$ Dissolved Oxygen: $\pm 10\%$ Oxidation/Reduction Potential: ± 10 millivolts (document says microvolts, but that may be an error)</p>
Michigan	<p>MDEQ Part 201 Op Memo 2, Attachment 5 http://www.michigan.gov/documents/deq/deq-rrd-OpMemo_2_Attachment5_249853_7.pdf</p>	<p>No specific values to determine stabilization are listed, but the Op Memo lists several other groundwater sampling guidance documents. If a valid reference exists, then it can be used to justify a sampling approach and stabilization parameters.</p>
New Jersey	<p>New Jersey Department of Environmental Protection http://www.state.nj.us/dep/srp/guidance/fspm/</p>	<p>pH: ± 0.1 unit Specific Conductance: $\pm 3\%$ Temperature: $\pm 3\%$ Dissolved Oxygen: $\pm 10\%$ Turbidity: $\pm 10\%$ for values greater than 1 NTU ORP/Eh: ± 10 millivolts</p>
Ohio	<p>Ohio EPA SOPs: http://www.epa.state.oh.us/portals/30/rules/FSOPs.pdf</p> <p>See Purging Stabilization Criteria (SOP 2.2.4, dated January 2, 2007, review in progress)</p>	<p>pH: ± 0.1 unit Specific Conductance: $\pm 3\%$ Temperature: No criteria specified Turbidity: Below 10 NTUs ideal; $\pm 10\%$ if greater than 10 NTUs Dissolved Oxygen: ± 0.3 mg/L Oxidation/Reduction Potential: ± 10 millivolts</p>
This table was last updated in July 2014.		

Attachment B:

Example Groundwater Field Data Records

 Groundwater Field Data Record		Project: _____ Project No.: _____		Date/Time: _____		Sheet ____ of ____																	
WELL INTEGRITY <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>YES</th> <th>NO</th> </tr> </thead> <tbody> <tr> <td>Protect. Casing Secure</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Concrete Collar Intact</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>PVC Stick-up Intact</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Well Cap Present</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Security Lock Present</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table>			YES	NO	Protect. Casing Secure	<input type="checkbox"/>	<input type="checkbox"/>	Concrete Collar Intact	<input type="checkbox"/>	<input type="checkbox"/>	PVC Stick-up Intact	<input type="checkbox"/>	<input type="checkbox"/>	Well Cap Present	<input type="checkbox"/>	<input type="checkbox"/>	Security Lock Present	<input type="checkbox"/>	<input type="checkbox"/>	TRC Personnel: _____ Well ID: _____ Protective Casing Stick-up _____ ft. (from ground) _____ Riser Stick-up _____ ft. (from ground) _____ WELL DIAMETER <input type="checkbox"/> 2 inch <input type="checkbox"/> 4 inch Other: _____ <input type="checkbox"/> 6 inch WELL MATERIAL <input type="checkbox"/> PVC <input type="checkbox"/> SS Other: _____		Well Depth _____ ft. <input type="checkbox"/> top of riser <input type="checkbox"/> measured <input type="checkbox"/> top of casing <input type="checkbox"/> historical Water Depth _____ ft. LNAPL/DNAPL Depth = _____ Well Volume _____ NAPL Thickness = _____ Depth of pump intake: _____ Static water level after pump put into well: _____ Initial purge Rate/ Water Level (100-400 ml/min): _____ Adjusted purge Rates/time/WL(record changes) _____ Flow rate at time of sampling: _____ Total volume of water purged: _____	
	YES	NO																					
Protect. Casing Secure	<input type="checkbox"/>	<input type="checkbox"/>																					
Concrete Collar Intact	<input type="checkbox"/>	<input type="checkbox"/>																					
PVC Stick-up Intact	<input type="checkbox"/>	<input type="checkbox"/>																					
Well Cap Present	<input type="checkbox"/>	<input type="checkbox"/>																					
Security Lock Present	<input type="checkbox"/>	<input type="checkbox"/>																					
FIELD WATER QUALITY MEASUREMENTS (record at appropriate intervals)																							
Time																							
Temp. (°C)																							
Conduct. (µmhos/cm)																							
DO (mg/L)																							
pH (su)																							
ORP (millivolts)																							
Turbidity (NTU)																							
Flow (ml/min)																							
Depth To Water (ft)																							
Cumulative Purge Vol. (gal or L)																							
Time							Stabilization Criteria* (3 consecutive readings) - Temperature: ± 3 % - Conduct. (µmhos/cm): ± 3 % - DO (mg/L): ± 10 % (for values >0.5 mg/L) - pH (Std. Units): ± 0.1 SU - ORP (millivolts): ± 10 mV - Turbidity (NTU): +/- 10 % (for values >5.0 NTUs) - Drawdown: < 0.3 ft (can be greater as long as water level stabilizes above well screen)																
Temp. (°C)																							
Conduct. (µmhos/cm)																							
DO (mg/L)																							
pH (Std. Units)																							
Eh/ORP (millivolts)																							
Turbidity (NTU)																							
Flow (ml/min)																							
Depth To Water (ft)																							
Cumulative Purge Vol. (gal or L)																							
Peristaltic Pump <input type="checkbox"/> Submersible Pump <input type="checkbox"/> Bladder Pump <input type="checkbox"/> Bailer <input type="checkbox"/> Other: _____ <input type="checkbox"/>		Purge <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Sample <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Comments: _____ _____ _____ _____																			
Analytical Parameter	Filtered (Y/N)	Preservation	# Bottles	Size/Type Bottles	Time Collected	QC	Sample #																


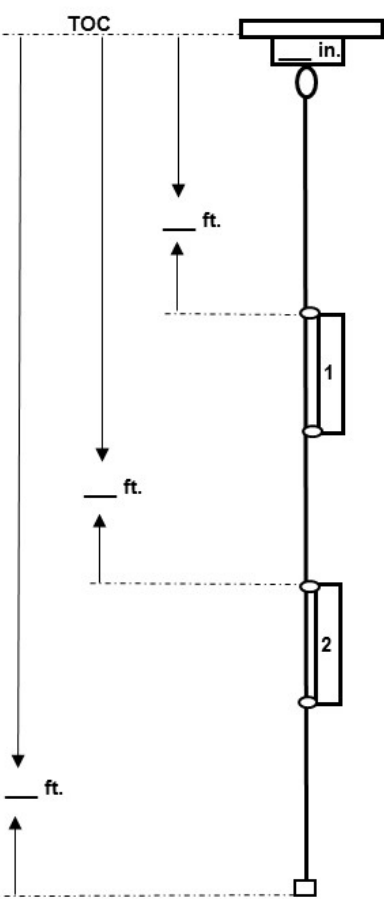
* Consult the applicable regulatory guidance for the specific criteria.

Signed: _____

Rev: April 2014



Groundwater Sampling
Procedure No: ECR 009
TRC Controlled Document

 Groundwater Sampling Record for Organics (For Wells with Passive Diffusion Bags)		Project Name/No: _____	Well ID: _____				
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="background-color: #d3d3d3; padding: 5px;">Installation of PDBs:</th> </tr> <tr> <td style="padding: 5px;"> TRC Personnel: _____ Date: _____ Time: _____ DTW (ft): _____ </td> </tr> </table>		Installation of PDBs:	TRC Personnel: _____ Date: _____ Time: _____ DTW (ft): _____	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="background-color: #d3d3d3; padding: 5px;">Sampling of PDBs:</th> </tr> <tr> <td style="padding: 5px;"> TRC Personnel: _____ Date: _____ DTW (ft): _____ </td> </tr> </table>		Sampling of PDBs:	TRC Personnel: _____ Date: _____ DTW (ft): _____
Installation of PDBs:							
TRC Personnel: _____ Date: _____ Time: _____ DTW (ft): _____							
Sampling of PDBs:							
TRC Personnel: _____ Date: _____ DTW (ft): _____							
<div style="display: flex; align-items: center;"> <div style="flex: 1;">  <div style="flex: 1; margin-left: 20px;"> <p>PDB #1 Length: ___ in.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Sample ID: _____ Sample Time: _____ Evidence of algae, iron or other coatings?: _____ </div> <p>PDB #2 Length: ___ in.</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> Sample ID: _____ Sample Time: _____ Evidence of algae, iron or other coatings?: _____ </div> </div> </div> </div>							
Field Notes: <div style="border: 1px solid black; height: 100px; margin-top: 5px;"></div>							

Rev. April 2014

Attachment C: SOP Fact Sheet

GROUNDWATER SAMPLING

PURPOSE AND OBJECTIVE

The objective of groundwater sampling is to obtain a representative sample of water from a saturated zone or groundwater-bearing unit (i.e., aquifer) with minimal disturbance of groundwater chemistry. This requires that the sample being collected is representative of groundwater within the formation surrounding the well bore as opposed to stagnant water within the well casing or within the filter pack immediately surrounding the well casing.

There are three general approaches to groundwater purging/sampling that can be used to obtain a representative groundwater sample for analysis: 1) the low-flow or micropurge method where the mixing of the stagnant water is minimized using low-flow pumping rates during the collection of the groundwater sample; 2) the multiple well volume removal approach in which the stagnant water is removed from the well and the filter pack prior to sample collection; and 3) the passive sampler procedure where water quality equilibration with the surroundings is achieved through deployment of the passive sampler for a sufficient amount of time prior to sampling. All three approaches are summarized in this document.

WHAT TO BRING

- | | |
|--|--|
| <ul style="list-style-type: none"> • Site-specific HASP and field book • Project-specific work plan • Figure or site map showing well locations and table showing well construction details • Field data sheets from previous sampling event • Well wrenches, ratchet set, and turkey baster to remove standing water from flushmount manholes • Bolt cutters, padlocks and keys • Water level meter of sufficient length • Decontaminated pump, control box, power source (i.e., battery, generator, etc.) • Tubing (Teflon®, Teflon®-lined polyethylene, or HDPE, type dependent upon project objectives) • Multi-parameter instrument and flow-through cell (typically should include: pH, temperature, conductivity, ORP, and DO) • Turbidity meter • Equipment decontamination supplies (refer to RMD SOP 010, <i>Equipment Decontamination</i>) • Appropriate PPE • Field book | <ul style="list-style-type: none"> • Sample bottleware, labeled cooler, ice, temperature blank and blank COC forms; may also need field blank bottles and reagent-grade water • Zip-loc® plastic bags • Groundwater field data records • Graduated cylinder and stop-watch • Rope for tying off pump at desired intake • Indelible marking pens • Bubble wrap • 5-gallon bucket(s) <p>As Needed:</p> <ul style="list-style-type: none"> • Calibrated PID or FID for well mouth readings • Oil/water interface probe of sufficient length • Drums for purge water, grease pen and adhesive drum labels; appropriate crescent or socket wrench • Filtration equipment, if required (0.45 micron filters, or as otherwise required for the project) • Other non-routine PPE such as Tyvek coveralls or respirators • Traffic cones • Field calibration sheets and calibration solutions |
|--|--|

OFFICE

- | | |
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| <ul style="list-style-type: none"> • Prepare/update the site-specific HASP; make sure the field team is familiar with the most recent version. • Review the project-specific work plan with the Project Manager and/or the field team leader. Discuss the following: <ul style="list-style-type: none"> ○ Communication procedures; ○ Sampling order and designation; ○ Collection and sample method; ○ Analytical parameters, holding times and turn-around times; ○ Laboratory (contact/shipping info, COC, billing references); ○ Purge water management (Drums? Discharge to ground?); ○ QC sample collection; and ○ Decontamination procedures. | <ul style="list-style-type: none"> • Verify that monitoring wells will be accessible and/or coordinate to have a site contact available to assist. • Make sure that monitoring well sample designations and QC sample designations/frequency are understood. • Confirm that all necessary equipment is available in-house or has been ordered. Rental equipment is typically delivered the day before fieldwork is scheduled. Prior to departure or mobilization to site, test equipment and make sure it is in proper working order. Have rental equipment supplier contact information available for use in field. • Review sample bottle order for accuracy and completeness and damaged bottles. • Discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager |
|---|--|

ON-SITE

GROUNDWATER SAMPLING

- Review the HASP with all field personnel, sign acknowledgement form and conduct Health & Safety tailgate meeting. Check in security, site contact, or designated person per project-specific work plan or Project Manager.
- Make sure appropriate PPE is worn by all personnel and work area is safe (i.e., utilize traffic cones; minimize interference with on-site activities and pedestrian traffic, etc.)
- Calibrate equipment (if applicable) and record all rental equipment serial numbers in the field book.
- Open wells to allow equilibration and collect full round of water level gauging before sampling is started (unless otherwise noted in project-specific work plan). Record the following:
 - Well mouth PID/FID reading (if necessary);
 - Depth to product and water;
 - Total well depth (not required if free product is measured unless otherwise noted in project-specific work plan); and
 - Condition of wells (i.e., lid broken, pad cracked, rusted lock) and collect photographs if site allows camera use.

SAMPLING PROCEDURES: PRE-PURGE

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| <ul style="list-style-type: none"> • Decontaminate pump. • Take water level measurements prior to pump installation. • Connect sampling tubing to pump outlet and lower to sample depth; ALWAYS USE ROPE TO SECURE PUMP TO SURFACE. • The pump intake depth(s) for each well should be specified in the project-specific work plan (either specific depth or mid-point of saturated well screen). • For wells with screened or open borehole intervals greater than 10 feet in length, sampling of multiple intervals may be required. • If samples are to be collected from multiple depths from an individual well, always collect a sample from the shallowest depth first and leave enough extra tubing coiled at the surface so the pump can be lowered to the next interval; always try to cover excess tubing present | <p>at the surface to prevent the air temperature from influencing the measurements and exposure to contaminants on the ground;</p> <ul style="list-style-type: none"> • Be careful not to let the pump hit the bottom of the well. • If using Teflon®-lined tubing, be sure that the lining does not bunch up around the connection. This will restrict water flow and make the pump work harder than it has to. • Calibrate (or perform a calibration check on) all field monitoring equipment on the same day before collecting groundwater samples. Refer to TRC SOPs and manufacturer's equipment calibration instructions. A calibration check may also be required during or at the end of each sampling day. Consult the project-specific work plan. |
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SAMPLING PROCEDURES: MULTIPLE-VOLUME PURGING

- | | |
|--|--|
| <ul style="list-style-type: none"> • The multiple-volume purging approach is typically performed using bailers or submersible or peristaltic pumps. In the multiple-volume purging approach, there are two measurements used to determine adequate purge volume removal prior to sample collection: 1) purge volume and 2) field parameter stabilization. • The field parameters should be recorded at regular volumetric intervals. There are no set criteria for establishing how many total sets of measurements are adequate to document stability of parameters. • Prior to purging a well, the amount of water inside the well riser and well screen (i.e., water column) should be determined, if possible. Once this information is known, the well volume can be calculated using the following equation:
 $\text{Well Volume (V)} = \pi r^2 h$ • For volumetric purging, an adequate purge is typically achieved when 3 to 5 well volumes have been removed. | <ul style="list-style-type: none"> • For volumetric purging, it is suggested that field readings are collected every ½ well/well screen volume after an initial 1 to ½ well volumes are purged. The volume removed between readings can be adjusted as well-specific information is developed. • If removing a specified volume of water (e.g., 3 well volumes) has been determined to be suitable for purging, sampling can commence immediately upon achieving the required purge volume. • In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection. • If, after 3 well volumes have been removed, the field parameters have not stabilized, additional well volumes (up to a total of 5 well volumes), should be removed. • If the parameters have not stabilized within five well volumes, it is at the discretion of the Project Manager whether or not to collect a sample or to continue purging. |
|--|--|

SAMPLING PROCEDURES: LOW-FLOW PURGING

- The low-flow purging approach is typically performed using peristaltic pumps or submersible pumps. Low-flow purging (also referred to as low-stress purging, low-volume purging, or Micropurging®) is a method of well purging/sampling that minimizes the volume of water withdrawn from a well in obtaining a representative sample.
- When performing low-flow purging and sampling, it is recommended that the pump intake be set in the center of the well screen interval to help prevent disturbance of any sediment at the bottom of the well.

GROUNDWATER SAMPLING

- To begin purging, the pump should be started at the lowest pressure/power flow rate setting (e.g., 100 mL/min) and then slowly increased until water begins discharging. Monitor the water level and slowly adjust the pump speed until there is little or no drawdown or drawdown has stabilized. The pump pressure/power may need to be increased for discharge to occur.
- The stabilization of drawdown should be documented. Measure and record the flow rate and water level every 3 to 5 minutes during purging. The flow rate should be reduced if drawdown is greater than 0.3 feet over three consecutive 3 to 5 minute interval readings.
- Attempts should be made to avoid pumping a well dry.

Field Parameter Stabilization During Purging

- Generally, an adequate purge with respect to the groundwater chemistry is achieved when stability for at least three consecutive measurements is achieved. See stability requirements in Appendix A of this SOP.

POST-PURGE GROUNDWATER SAMPLE COLLECTION

- New, disposable gloves should be donned immediately prior to sample collection and should be changed at any point that their cleanliness becomes compromised during sample collection.
- If using a submersible or peristaltic pump, maintain the same flow rate as used during purging. Disconnect the pump tubing from the flow-through cell. Samples must be collected directly from the discharge port of the pump tubing prior to passing through the flow-through cell. This is critically important to avoid cross-contamination between wells.
- If using bottom-filling bailers, slowly lower the bailer into the well until it is submerged to the point where water does not enter the top (i.e., bottom-filling). Retrieve the bailer. The first bailer recovered after well purging must be used for sample collection.
- Collect groundwater samples in the following order:
 - VOCs;
 - SVOCs;
 - Other organic parameters;
 - Unfiltered inorganic constituents; and
 - Filtered inorganic constituents.
- Note that sample vials for VOCs must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, see Section 2.3.2 of this SOP.
- Preserve the non-VOC samples in pre-preserved vials supplied by the laboratory or if the sample containers are not pre-preserved, preserve the non-VOC samples in accordance with method and project-specific requirements.
- Depending upon project requirements, filtering may be performed. See procedures listed in Section 2.3.4 of this SOP. Clearly note "filtered" on the sample label and the COC.
- Make sure all sample bottles are appropriately labeled.
- Package the samples with bubble wrap and/or organic absorbent, as necessary. Place into shipping container and cool to 4°C and complete the COC.
- Decontaminate non-disposable sampling equipment between uses.

PASSIVE SAMPLING

- There are three generic forms of passive (no purge) samplers: thief (grab) samplers, diffusion (equilibrium) samplers, and integrating (kinetic) samplers. However, this SOP focuses on the more commonly used diffusion (equilibrium) samplers. Be aware of sample holding times, and arrange for samples to be in the laboratory's possession accordingly.
- Passive samplers are deployed at a predetermined depth across the well screen. Typically, the initial sampling event may deploy multiple passive samplers across 5-foot intervals of saturated well screen to observe any potential stratification. Long-term sampling depths typically target a zone of higher concentration, if present.
- New passive samplers are attached via PVC cable ties to a tether (pre-made marine-grade polyethylene rope or stainless steel cable with a weight at the bottom) that is then suspended within the well.
- The passive sampler should be allowed to equilibrate with groundwater for an appropriate period of time (e.g., at least 2 weeks for PDB samplers).
- Raise the passive sampler to the surface using a tether reel. Examine the surface of the passive sampler for evidence of algae, iron, or other coatings, and for tears to the membrane. Note observations in the field book. If tears are present and water is leaking out, the sample is not considered viable. Contact the Project Manager.
- Detach the passive sampler from the tether.
- Remove excess beaded water from the passive sampler with a clean gloved hand, running top to bottom; this is to minimize the contact of beaded water with water in the passive sampler.

GROUNDWATER SAMPLING

- Use a small diameter discharge tube (<0.15 inch diameter to reduce volatilization) and pierce near the bottom, allowing water to smoothly flow into the VOA vial. The VOA vials must be filled within the first several minutes of passive sampler retrieval.
- A small amount of water may remain within the passive sampler after filling the VOA vials and can be used for field parameter measurements if required.
- Dispose of the passive sampler after use.
- Note that sample vials for VOCs must be filled so a meniscus forms over the mouth of the vial. This ensures no air bubbles or headspace will be formed after it has been capped. Ensure the lack of air bubbles and headspace by turning the vial upside down and tapping it lightly. If any bubbles are observed, see Section 2.3.2 of this SOP.
- Make sure all sample bottles are appropriately labeled.
- Package the samples with bubble wrap and/or organic absorbent, as necessary. Place into shipping container and cool to 4°C and complete the COC.

DOs AND DO NOTs OF GROUNDWATER PURGING AND SAMPLING

DOs:

- DO have the following items when going into the field: site-specific work plan; site-Specific HASP; appropriate PPE (steel-toed boots, safety glasses, etc.) as required by the Site-Specific HASP; field book and a water-proof ball-point pen; business cards; nitrile gloves; well keys; copies of well installation forms and field data forms from previous sampling event.
- DO make sure that the equipment is set up properly and the bottle/ware is nearby and ready to be filled. There is little time between taking parameters.
- DO look at the water quality parameters from the previous round of sampling. If there is a large deviation from the previous round's measurements, make sure the meters are properly calibrated and the parameter units are the same. Otherwise, consult the Project Manager or field team leader.
- DO fill sample bottles slowly to make sure that they are not overfilled and that preservative does not become diluted. If collecting filtered samples, fill all non-filtered first, then fill filtered samples - if water is very silty, more than one filter might be required to fill sample bottles.
- DO record the time that purging begins and ends. "Purge Stop" and sample start time are the same.
- DO call your Project Manager or field team leader if unexpected conditions are encountered or at least daily to update them. It is also recommended to call when sampling is winding down for the day to make sure that the project-specific work plan has been fully implemented and there are no additional tasks to complete. Provide shipping tracking numbers to the Project Manager and laboratory contact.
- DO have the numbers for laboratory, vehicle rental and equipment rental providers readily available while in the field.
- DO record sample locations and parameters in the field book and the Groundwater Field Data Records as you purge.
- DO check on the purging setup frequently to make sure proper equipment function is maintained.
- DO bring ice to the site in the morning so that samples are kept cool throughout the entire event. Storing samples in a warm cooler can invalidate sample results and may result in re-sampling on your own time.

DO NOTs:

- DO NOT sign anything in the field. This includes disposal documentation, statements, etc.; call the Project Manager if this is an issue.
- DO NOT allow the pump or sampling equipment to hit the bottom of the well - If the pump hits the bottom of the well, it can stir up mud. Remember, the goal of low-flow sampling is to collect non-turbid samples.
- DO NOT use non-indelible ink to label samples or record field notes - if the field book gets wet, notes become illegible.
- DO NOT leave air bubbles in VOA vials.
- DO NOT pour any extracted water back down into the well.
- DO NOT lean over wells with pens, keys, cell phones, tools, etc. in your pocket.
- DO NOT use clear tape to cover labels on certain analyses (e.g., 40-mL vials for VOC analysis) due to potential interference with analytical equipment.

Attachment D: SOP Modifications for PFAS

Due to the pervasive nature of PFAS in various substances routinely used during sampling and the need to mitigate potential cross-contamination or sampling bias to ensure representative data are collected, special care should be taken when sampling for PFAS. The following table highlights the required modifications to this SOP when sampling for PFAS.

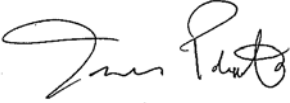

PFAS Sampling Protocols	
SOP Section Number	Modifications to SOP
1.3	<ul style="list-style-type: none"> Do not use equipment utilizing Teflon® or low density polyethylene (LDPE)¹ during sample handling or mobilization/demobilization. This includes bailers, tubing, bladders, bailer cord/wire, waterproof/resistant paper products, certain personal protective equipment (PPE) (see below), and Teflon® tape. High density polyethylene (HDPE) or silicone tubing should be used in lieu of Teflon® or Teflon®-lined tubing. Passive diffusion bags (PDBs) should not be used due to the presence of LDPE material in PDBs. Blue Ice® (chemical ice packs) must not be used to cool samples or be used in sample coolers. Regular ice in Ziploc® bags can be used. Do not use LDPE or glass sample containers or containers with Teflon-lined lids. HDPE or polypropylene containers are acceptable for sample storage. HDPE or polypropylene caps are acceptable. Do not use aluminum foil. Field notes should be recorded on loose paper field forms maintained in aluminum or Masonite clipboards. Waterproof field books, plastic clipboards and spiral bound notebooks should not be used. Do not use Post-It Notes during sample handling or mobilization/demobilization. Refer to TRC's SOP ECR-010 Equipment Decontamination for PFAS-specific decontamination protocols. Ensure that PFAS-free water is used during the decontamination procedure.
1.5	<p>Always consult the Site Specific Health and Safety Plan prior to conducting field work. The following considerations should be made with regards to field preparation during PFAS sampling:</p> <ul style="list-style-type: none"> Tyvek® suits should not be worn during PFAS sampling events. Cotton coveralls may be worn. Boots and other field clothing containing Gore-Tex™ or other waterproof/resistant material should not be worn. This includes rain gear. Boots made with polyurethane and polyvinyl chloride (PVC) are acceptable. Stain resistant clothing should not be worn. Food and drink should not be allowed within the exclusion area. Pre-wrapped food or snacks should not be in the possession of sampling personnel during sampling. Bottled water and hydration drinks (e.g., Gatorade®) may be consumed in the staging area only. Personnel involved with sample collection and handling should wear

PFAS Sampling Protocols	
SOP Section Number	Modifications to SOP
	<p>nitrile gloves at all times while collecting and handling samples or sampling equipment. Avoid handling unnecessary items with nitrile gloves. A new pair of gloves must be donned prior to collecting each sample.</p> <ul style="list-style-type: none"> Wash hands with Alconox or Liquinox and deionized water after leaving vehicle before setting up to sample a well.
1.6.1	<ul style="list-style-type: none"> Avoid wearing clothing laundered with fabric softeners. Avoid wearing new clothing (recommended 6 washings since purchase). Clothing made of cotton is preferred. Avoid using cosmetics, moisturizers, hand creams, or other related products as part of cleaning/showering on the day of sampling. Avoid using sunscreens or insect repellants that are not natural or chemical free.
2.2.5	Tubing used to purge and sample groundwater for PFAS must not be LDPE or Teflon®. HDPE and silicone are acceptable.
2.3 and 2.3.3	LDPE and/or glass containers should not be used for sampling. Teflon®-lined caps should also not be used during sample collection. Instead, HDPE or polypropylene containers are acceptable for sample storage. HDPE or polypropylene caps are acceptable.
2.4	Due to LDPE material in PDBs, PDBs cannot be used for PFAS sampling.
2.5 (e)	Avoid using waterproof labels for sample bottles. The use of paper labels covered with clear tape or placed in Ziploc® bags to avoid moisture on the sample label is acceptable.
2.5 (f)	Samples for PFAS analysis must be shipped at <10°C. Standard coolers are acceptable.
4.3	Due to low reporting limit requirements for PFAS, trip blanks for PFAS analysis should be included in sample coolers if PFAS are being analyzed for in the associated groundwater samples.

Notes:

¹ – PFAS have been used as an additive in the manufacturing of LDPE to smooth rough surfaces and, in the case of LDPE tubing, to allow for less turbulent flow along the surface of the tubing.



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ATTACHMENTS

Attachment A	SOP Fact Sheet
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1.0 INTRODUCTION

1.1 Scope & Applicability

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the procedures needed for decontamination of equipment used in the field during environmental investigations (e.g., sediment, soil, groundwater investigations). Other state or federal requirements may be above and beyond the scope of this SOP and will be followed, if applicable. In all instances, the actual procedures used should be documented and described in the field notes. Preventing or minimizing potential cross-contamination of samples is important for the collection of representative samples, avoiding the possible introduction of sampling error into sample results, and for protecting the health and safety of site personnel.

Removing or neutralizing potential contaminants that may have accumulated on equipment and vehicles ensures protection of personnel, reduces or eliminates potential transfer of contaminants to clean areas, and minimizes the likelihood of sample cross-contamination.

The use of dedicated, disposable, new sampling equipment (e.g., disposable liners, plastic spoons, plastic or aluminum bowls) should be considered as an alternative to equipment decontamination and the subsequent generation of decontamination fluids.

1.2 Summary of Method

Equipment decontamination is used to remove potential contaminants from a sampling device or piece of field equipment prior to and between the collection of samples and is also used to limit personnel exposure to residual contamination that may be present on used field equipment.

Contaminants can be physically removed from equipment or deactivated by sterilization or disinfection. Gross contamination of equipment requires physical decontamination, including abrasive and nonabrasive methods. These include the use of brushes, air and wet blasting, and high-pressure water, followed by a wash/rinse process using appropriate cleaning solutions. A solvent rinse may be required when organic contamination is present, and an acid rinse may be required when metals are parameters of interest. Equipment decontamination procedures can vary depending on the media being sampled and the type of sampling equipment being used. Disposal of decontamination fluids will be handled on a project-specific basis and will be in accordance with all applicable regulations.

1.3 Equipment

The following equipment may be utilized when decontaminating equipment. Project-specific conditions or requirements may warrant the use of additional equipment or deletion of items from this list. For specialized sampling programs involving per- and polyfluorinated alkyl substances (PFAS), refer to Attachment B for further details.

- Appropriate level of personal protective equipment (PPE) as specified in the site-specific Health and Safety Plan (HASP)

- Alconox®, Liquinox® or other nonphosphate concentrated laboratory-grade soap
- Simple Green® or other nontoxic biodegradable cleaner
- Deionized, distilled, or organic-free water, as appropriate (may be supplied by the laboratory or purchased from commercial vendors depending on project requirements)
- Pump sprayer
- Pressure sprayer
- Squeeze bottle filled with pesticide-grade hexane (option for organic analyses)
- Squeeze bottle filled with pesticide-grade methanol (option for organic analyses)
- Squeeze bottle filled with pesticide-grade isopropanol (option for organic analyses)
- Squeeze bottle filled with 10 percent nitric acid (option for metals analyses and stainless-steel equipment)
- Squeeze bottle filled with 1 percent nitric acid (option for metals analyses)
- Container (squeeze bottle to 5-gallon bucket) filled with potable water and a nonphosphate, laboratory-grade soap (approximately 1 tablespoon of soap to 5 gallons of water)
- Extra quantities of above listed liquids
- Potable water
- Containers, such as buckets or wash basins (the type and number of containers is dependent on the procedure)
- Scrub brushes
- Small wire brush
- Aluminum foil
- Polyethylene sheeting
- A container for decontamination of pumps and associated tubing.

1.4 Health & Safety Considerations

TRC personnel will be on site when implementing this SOP. Therefore, TRC personnel shall follow the site-specific HASP. TRC personnel will use the appropriate level of PPE as defined in the HASP.

Samples containing chemical contaminants may be handled during implementation of this SOP. Certain decontamination fluids, including solvents and/or acids, are considered hazardous materials, and TRC employees will appropriately handle and store them at all times. Appropriately manage chemicals that pose specific toxicity or safety concerns, and follow any other relevant requirements as appropriate. Hazardous substances may be incompatible or may react to produce heat, chemical reactions, or toxic products. Some hazardous substances may be incompatible with clothing or equipment and can permeate or degrade protective clothing or equipment. Also, hazardous substances may pose a direct health hazard to workers through

inhalation or skin contact or if exposed to heat/flame and they combust. Safety data sheets for chemicals handled by TRC personnel should be maintained in a designated location at the project site.

1.5 Cautions and Potential Problems

Special care should be taken when decontaminating equipment used for sampling for PFAS. Please refer to Attachment B for details.

- The use of deionized, distilled or organic-free water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been certified by the vendor as analyte-free and/or meets the project-specific requirements.
- Alconox®, Liquinox®, or other nonphosphate, concentrated, laboratory-grade soap may contain trace quantities of perchlorate.
- Avoid using an excessive amount of soap during decontamination procedures, as this could result in difficulty rinsing the soap residue off of the equipment. Typically the soap solution is prepared using 1 tablespoon of soap to 5 gallons of water.
- Use sufficient amount of decontamination fluid (e.g., acid or solvent rinses) so that the fluid flows over the equipment and runs off. Spraying the equipment with a minimal amount of decontamination fluid that does not run off is ineffective.
- Spent decontamination solutions are considered investigation-derived waste (IDW) and must be managed as directed by the site-specific field program. Project and regulatory requirements, chemical compatibility, ambient conditions and professional judgment should be used to determine the appropriate decontamination process with respect to combining and/or segregating decontamination fluids. Section 3 of this SOP provides more guidance on the disposal procedures.
- Several procedures can be established to minimize the potential for cross-contamination or analytical interference by decontamination fluids. For example:
 - The use of methanol in the decontamination procedure may not be appropriate if methanol is a contaminant of concern.
 - Isopropanol may be used as a substitute for methanol but may not be appropriate when collecting samples for volatile organic compound (VOC) analyses. Residual isopropanol on the equipment may cause substantial interferences in subsequent VOC analyses and may result in unnecessary dilutions and/or false positive results if isopropanol is not removed in subsequent decontamination steps. It should also be noted that the application of isopropanol to hot metal surfaces (e.g., a steam-cleaned split spoon) may cause oxidation of the isopropanol to acetone.

- If hexane is used in the decontamination procedure, caution should be used to ensure that the hexane is completely volatilized and the equipment is subsequently rinsed when samples are to be analyzed for VOCs and volatile petroleum hydrocarbons (VPH). Residual hexane on equipment could interfere with the VOC and VPH analyses and may result in unnecessary dilutions and/or false positive results.
 - Cover monitoring and sampling equipment with protective material (i.e., aluminum foil, polyethylene sheeting, or Ziploc® bags) to minimize potential re-contamination after decontamination.
 - Use disposable sampling equipment when appropriate to minimize the need for decontamination. Although disposable sampling tools are encouraged in order to minimize the generation of decontamination fluids, it should be noted that plastic tools may not be appropriate for collection of samples to be analyzed for semivolatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). Potential phthalate contamination may cause significant interferences in the subsequent analyses and may result in unnecessary dilutions and/or false positive results.
- After decontamination, equipment should be handled only by personnel wearing clean disposable powder-free nitrile gloves to prevent recontamination.
 - If equipment decontamination is performed in the field, the equipment should be moved away (preferably upwind) from the decontamination area to prevent recontamination.
 - Equipment that is not decontaminated properly may result in potentially high biased results in field samples. **Note:** Equipment blank collection may be appropriate after decontamination of equipment used to collect highly contaminated samples.

1.6 Personnel Qualifications

Since this SOP will be implemented at sites or in work areas that entail potential exposure to toxic chemicals or hazardous environments, all TRC personnel must be adequately trained. Project and client-specific training requirements for samplers and other personnel on site should be developed in project planning documents, such as the sampling plan or project work plan. These requirements may include:

- Occupational Safety and Health Administration (OSHA) 40-hour Health and Safety Training for Hazardous Waste Operations and Emergency Response (HAZWOPER) workers
- 8-hour annual HAZWOPER refresher training.

2.0 PROCEDURES

Refer to the site-specific sampling plan and/or Quality Assurance Project Plan (QAPP), if applicable, for site-specific procedures. Other state or federal requirements may be above and beyond the scope of this SOP and will be followed if applicable. In all instances, the actual procedures used should be documented and described in the field notes.

2.1 General

All personnel, sample containers, and equipment leaving the contaminated area of a site must be decontaminated. Various decontamination methods will either physically remove contaminants by abrasive and/or washing actions, inactivate contaminants by disinfection or sterilization, or both. Decontamination procedures should be documented in the field book.

2.2 Physical Decontamination Procedures

In many cases, gross contamination can be removed by physical means. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and nonabrasive methods. In general, heavy equipment decontamination is conducted by drilling and construction subcontractors and not by TRC personnel. However, TRC personnel will typically need to document such decontamination efforts as part of project work.

ABRASIVE CLEANING METHODS APPROPRIATE FOR DRILLING EQUIPMENT (DRILLING RIGS, ETC.)

Abrasive cleaning methods involve rubbing and wearing away the top layer of the surface containing the contaminant. The following abrasive methods are available but are not commonly used:

- *Mechanical:* Mechanical cleaning methods use brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.
- *Air Blasting:* Air blasting is used for cleaning large equipment, such as bulldozers, drilling rigs, or auger bits. The equipment used in air blasting employs compressed air to force abrasive material through a nozzle at high velocities. The distance between the nozzle and the surface cleaned, as well as the pressure of air, the time of application, and the angle at which the abrasive material strikes the surface, determines cleaning efficiency. Air blasting has several disadvantages, including it is unable to control the amount of materials removed, it can aerate contaminants, and it generates large amounts of waste.
- *Wet Blasting:* Wet blasting, also used to clean large equipment, involves use of a suspended fine abrasive delivered by compressed air to the contaminated area. The amount of materials removed can be carefully controlled by using very fine abrasives. One disadvantage of this method is the generation of a large amount of waste.

NONABRASIVE CLEANING METHODS APPROPRIATE FOR FIELD EQUIPMENT (DRILLING AUGERS AND RIGS, ETC.)

Nonabrasive cleaning methods involve forcing the contaminant off of a surface with pressure. In general, less of the equipment surface is removed using nonabrasive methods. Special care should be taken during decontamination procedures following sampling for PFAS. Please refer to Attachment B for details. The following non-abrasive methods are available:

- *High-pressure Potable Water:* This method consists of a high-pressure pump, an operator-controlled directional nozzle, and a high-pressure hose. Flow rates typically range from 20 to 140 liters per minute.

This procedure is used the majority of the time and is more appropriate for equipment with painted surfaces.

- *Ultrahigh-Pressure Potable Water:* This system produces a pressurized water jet. The ultrahigh-pressure spray removes tightly adhered surface film. The water velocity ranges from 500 meters per second (m/sec) to 900 m/sec. Additives can enhance the method. This method is not applicable for hand-held sampling equipment.

This procedure is not commonly used but would be appropriate for carbon steel drilling rods and augers.

2.3 Procedure for Sampling Equipment

Sampling equipment, such as split-spoon samplers, shovels, hand augers, trowels, spoons, spatulas, bailers, tethers, dippers, and pumps, will be cleaned using the following procedure. Special care should be taken during decontamination procedures following sampling for PFAS. Please refer to Attachment B for details. **Note:** The overall number of containers needed for collection of decontamination fluids may vary depending on chemical compatibilities, project and regulatory requirements, and ultimate disposal methods for these fluids.

1. Lay out sufficient polyethylene sheeting on the ground or floor to allow placement of the necessary number of containers (e.g., plastic wash basins or buckets) and an air drying area. The number of decontamination steps and designated containers should be determined prior to field sampling based on the site-specific sampling plan. At a minimum, one container should be designated for the detergent wash. A second container should be designated for water rinsing. A third container may be designated for nonwater rinsing. If more than one, the nonwater rinsate fluids may need to be separated. Nonwater rinsate fluids should not be combined with the detergent wash during decontamination. Place the containers on the polyethylene sheeting. The decontamination line should progress from “dirty” to “clean”.

Note: In instances where acid or solvent rinses are required, additional containers may be needed to manage collection and subsequent disposal of the spent decontamination fluids.

2. Fill the first container with potable water. Add sufficient nonphosphate concentrated laboratory-grade soap to cause suds to form in the container. Do not use an excessive amount of the soap (approximately 1 tablespoon of soap to 5 gallons of water), or rinsing the soap residue off of the equipment will be difficult.
3. Brush any visible dirt off of the sampling equipment into a designated area before getting equipment wet.

4. Using a clean, coarse scrub brush, submerge and wash the sampling equipment in the soap solution in the first container, removing all dirt or visible hydrocarbons. Allow excess soap to drain off the equipment into the container when finished. If cleaning a pump that is not completely disassembled, run the submerged pump in the container long enough to allow sufficient contact time with the internal components of the pump.
5. Rinse the equipment with potable water over an appropriate container, using a coarse scrub brush or pressure sprayer to aid in the rinse if necessary. If an additional acid or solvent rinse is not required, proceed to Step 8.
6. ****If sampling for metals and if required by the project, rinse the equipment with nitric acid over an appropriate container. Consider using a container dedicated to acidic solutions to minimize the volume of liquid that needs to be neutralized later. A 10 percent nitric acid solution is used on stainless steel equipment. A 1 percent nitric acid solution is used on all other equipment. If not required, this step may be omitted.**

Rinse the equipment over an appropriate container using deionized, distilled or organic-free water. If cleaning a pump that is not completely disassembled, run the submerged pump in the container long enough to allow sufficient contact time with the internal components of the pump.

7. ****If sampling for organic parameters and if required by the project, rinse the equipment over an appropriate container using pesticide-grade methanol or isopropanol (see Cautions and Potential Problems). If oily, a pesticide-grade hexane rinse should follow the methanol/isopropanol rinse, or as an alternative, Simple Green® can be used if approved by the Project Manager. Consider using an appropriate container dedicated to volatile solvents to minimize the volume of liquid that subsequently needs to be managed as IDW. If not required, this step may be omitted.**

Allow the equipment to completely air dry prior to proceeding to the next step.

**** Steps 6 and 7 are optional and may be used on a site-specific basis. The site-specific sampling plan or QAPP, if available, should be consulted. In the absence of a sampling plan or QAPP, the Project Manager will decide upon the necessity of these steps.**

8. Rinse the equipment over an appropriate container using deionized, distilled or organic-free water. If cleaning a pump that is not completely disassembled, run the submerged pump in the container long enough to allow sufficient contact time with the internal components of the pump.
9. Allow the equipment to completely air dry on a clean surface (e.g., polyethylene sheeting or a clean container) (See*NOTE).

***NOTE** that if temperature or humidity conditions preclude air drying equipment, sufficient spares, if possible, should be available so that no item of sampling equipment need be used more than once. If an ample amount of spare equipment is not available and the equipment will not completely air dry, additional rinses with deionized, distilled or organic-free water

should be used. The inability of equipment to air dry and the usage of additional rinses should be recorded in the field book or on the appropriate form.

10. Reassemble equipment, if necessary, and wrap completely in clean, unused, protective material. Reuse of equipment on the same day without wrapping in protective material is acceptable.
11. Spent decontamination fluids are considered IDW and must be managed as directed by the site-specific field program.
12. Record the decontamination procedure in the field book or on the appropriate form.

2.4 Procedure for Measuring Equipment

Measuring equipment, such as pressure transducers, water level indicators, oil/water interface probes, and soil moisture/pH meters will be cleaned using the following procedure, unless it conflicts with the manufacturer's recommendations. Special care should be taken during decontamination procedures following sampling for PFAS. Please refer to Attachment B for details.

1. Fill two clean containers (e.g., plastic wash basins or buckets) with potable water.
2. Add sufficient nonphosphate concentrated laboratory-grade soap to one container to form a thin layer of soap suds. If oily residues are apparent, the use of Simple Green® may be required.
3. Brush any visible dirt off of the measuring equipment before getting the equipment wet.
4. Either spray rinse the device with the soap solution over the first container, or for heavily soiled equipment, immerse the device in the container containing soap and gently agitate. Scrub device if it is soiled. Do not submerge any electrical controls or take-up reels. Submerge only that portion of the device that came in contact with potential contaminants.
5. Immerse the device in the container containing the potable water and gently agitate. Do not submerge any electrical connectors or take-up reels. Submerge only that portion of the device that came in contact with potential contaminants.
6. Spray rinse equipment with deionized, distilled, or organic-free water over the last container used.
7. Allow the equipment to air dry if time allows.
8. Record the decontamination procedure in the field book or on the appropriate form.

3.0 INVESTIGATION-DERIVED WASTE DISPOSAL

Field personnel should discuss specific documentation and containerization requirements for IDW disposal with the Project Manager.

Each project must consider IDW disposal methods and have a plan in place prior to performing the field work. Provisions must be in place regarding what will be done with IDW. If IDW cannot be returned to the site, consider material containment, such as a composite drum, proper labeling, on-site storage by the client, testing for disposal approval of the materials, and ultimately the pickup and disposal of the materials by appropriately licensed vendors.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

One type of quality control sample specific to the field decontamination process is the equipment blank. The equipment blank provides information about the effectiveness of the decontamination process employed in the field. An equipment blank can detect contamination that may arise from potentially contaminated equipment or equipment that has not been decontaminated effectively.

Equipment blanks consist of a sample of analyte-free (i.e., deionized, distilled, organic-free) water that is poured over and through a decontaminated sampling device and placed in a clean sample container. Ideally, the reagent water should come from the laboratory and be certified as clean. If the blank water is not certified as clean and/or not supplied by the laboratory performing the analyses, a separate water blank that has not run through the sampling equipment should also be sent to the laboratory for analysis.

Equipment blanks are typically collected for all parameters of interest at a minimum rate of 1 per 20 samples for each parameter. The frequency of equipment blank collection will vary from project to project, depending upon the data quality objectives, and will be specified in either the site-specific sampling plan or QAPP. Equipment blanks are typically not required if dedicated sampling equipment is used.

5.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

All reagents used must be documented in the field book or on the appropriate form. Any deviations from the decontamination procedures specified in the sampling plan or QAPP must be approved by the Quality Assurance (QA) Officer and Project Manager and documented in the field book. The lot number and vendor of each reagent used should be documented in the field book. Refer to RMD SOP 001 for field documentation procedures.

6.0 REFERENCES

USEPA. December 1987. *A Compendium of Superfund Field Operations Methods*. EPA/540/P-87/001.

USEPA. January 1991. *Compendium of ERT Groundwater Sampling Procedures*. OSWER Directive 9360.4-06. PB91-9211275.

USEPA. November 1992. *RCRA Ground-Water Monitoring: Draft Technical Guidance*. EPA/530-R-93-001. USEPA Office of Solid Waste.

USEPA. January 1999. *Compendium of ERT Groundwater Sampling Procedures*. EPA/540/P-91/007. OSWER Directive 9360.4-06. PB91-921275.

USEPA. December 20, 2011. *Field Equipment Cleaning and Decontamination*. SESDPROC-205-R2. Region 4. Science and Ecosystems Support Division. Athens, Georgia.

7.0 SOP REVISION HISTORY

REVISION NUMBER	REVISION DATE	REASON FOR REVISION
1	DECEMBER 2016	ADDED ATTACHMENT B TO ACCOMMODATE SOP MODIFICATIONS REQUIRED WHEN SAMPLING FOR PFAS; CHANGED NAMING CONVENTION FOR SOP FROM RMD TO ECR.

Attachment A: SOP Fact Sheet

EQUIPMENT DECONTAMINATION

PURPOSE AND OBJECTIVE	
Removing or neutralizing potential contaminants that may have accumulated on equipment and vehicles ensures protection of personnel, reduces or eliminates potential transfer of contaminants to clean areas, and minimizes the likelihood of sample cross-contamination. Preventing or minimizing potential cross-contamination of samples is important for the collection of representative samples, avoiding the possible introduction of sampling error into sample results, and for protecting the health and safety of site personnel.	
WHAT TO BRING	
<ul style="list-style-type: none"> Field book Appropriate PPE Site-specific HASP Alconox®, Liquinox® or other nonphosphate concentrated laboratory-grade soap Simple Green® or other nontoxic biodegradable cleaner Deionized, distilled, or organic-free water, as appropriate Potable water (or water containers if potable water source on site or nearby) Pump or pressure sprayer Squeeze bottles filled with appropriate decontamination chemicals (e.g., organic solvents, nitric acid) Containers, such as buckets or wash basins (type and number is dependent on the procedure) Scrub brushes Aluminum foil Polyethylene sheeting 	
OFFICE	
<ul style="list-style-type: none"> Prepare/update the site-specific HASP; make sure the field team is familiar with the latest version. Review site-specific sampling plan/QAPP for decontamination procedures and procedures for management of investigation-derived waste (IDW) (e.g., used decontamination solutions). Confirm all required decontamination supplies are in stock or order as needed. 	
ON-SITE	
<ul style="list-style-type: none"> Verify project HASP including safety data sheets for decontamination chemicals used on site. Conduct daily Health & Safety tailgate meetings, as appropriate. Establish a designated equipment and personnel decontamination area. Provide for the proper collection and management of all IDW. Verify that appropriate PPE is worn by all site personnel (including subcontractors) and the work area is safe. 	
SAMPLING EQUIPMENT DECONTAMINATION - PROCEDURES	
<p>Sampling equipment, such as split-spoon samplers, shovels, hand augers, trowels, spoons, spatulas, bailers, tethers, dippers, and pumps, will be cleaned using the following procedure. A more simplified procedure for decontamination of measuring equipment is presented in the SOP. Note: The overall number of containers needed for collection of decontamination fluids may vary depending on chemical compatibilities, project and regulatory requirements, and ultimate disposal methods for these fluids.</p> <ol style="list-style-type: none"> Lay out sufficient polyethylene sheeting on the ground or floor and the necessary number of containers (e.g., plastic wash basins or buckets) and an air drying area. At a minimum, one container should be designated for the detergent wash. A second container should be designated for water rinsing. A third container may be designated for nonwater rinsing. Nonwater rinsate fluids should not be combined with the detergent wash during decontamination. The decontamination line should progress from “dirty” to “clean”. Note: In instances where acid or solvent rinses are required, additional containers may be needed to manage collection and subsequent disposal of the spent decontamination fluids. Fill the first container with potable water. Add sufficient nonphosphate concentrated laboratory-grade soap to cause suds to form in the container. Brush any visible dirt off of the sampling equipment before getting equipment wet. Using a clean, coarse scrub brush, submerge and wash the sampling equipment in the soap solution in the first container. 	

EQUIPMENT DECONTAMINATION

5. Rinse the equipment with potable water over an appropriate container. If an additional acid or solvent rinse is not required, proceed to Step 8.
6. ****If sampling for metals and if required by the project, rinse the equipment with nitric acid over an appropriate container. Consider using a container dedicated to acidic solutions to minimize the volume of liquid that needs to be neutralized later. A 10 percent nitric acid solution is used on stainless steel equipment. A 1 percent nitric acid solution is used on all other equipment. If not required, this step may be omitted.**
7. ****If sampling for organic parameters and if required by the project, rinse the equipment over an appropriate container using pesticide-grade methanol or isopropanol (see Caution and Potential Problems). If oily, a pesticide-grade hexane rinse should follow the methanol/isopropanol rinse, or as an alternative, Simple Green® can be used if approved by the Project Manager. Consider using an appropriate container dedicated to volatile solvents to minimize the volume of liquid that subsequently needs to be managed as IDW. If not required, this step may be omitted.**
Allow the equipment to completely air dry prior to proceeding to the next step.
**** Steps 6 and 7 are optional and may be used on a site-specific basis. The site-specific sampling plan or QAPP, if available, should be consulted. In the absence of a sampling plan or QAPP, the Project Manager will decide upon the necessity of these steps.**
8. Rinse the equipment over an appropriate container using deionized, distilled or organic-free water.
9. Allow the equipment to completely air dry on a clean surface (e.g., polyethylene sheeting or a clean container).
***NOTE that if temperature or humidity conditions preclude air drying equipment, sufficient spares, if possible, should be available so that no item of sampling equipment need be used more than once. If an ample amount of spare equipment is not available and the equipment will not completely air dry, additional rinses with deionized, distilled or organic-free water should be used. The inability of equipment to air dry and the usage of additional rinses should be recorded in the field logbook or on the appropriate form.**
10. Reassemble equipment, if necessary, and wrap completely in clean, unused, protective material. Reuse of equipment on the same day without wrapping in protective material is acceptable.
11. Spent decontamination fluids are considered IDW and must be managed as directed by the site-specific field program.

INVESTIGATION DERIVED WASTE (IDW) DISPOSAL

Field personnel should review the project work plan and ensure project-specific IDW management documentation and containerization requirements are specified or discussed with the Project Manager before going to the project site.

DATA MANAGEMENT AND RECORDS MANAGEMENT

All reagents used must be documented in the field book or an appropriate field form. Any deviations from the decontamination procedures specified in the work plan, sampling plan or QAPP must be approved by the Quality Assurance (QA) Officer and Project Manager and documented in the field book. The lot number and vendor of each reagent used should be documented in the field logbook. Refer to RMD SOP 001 for field documentation procedures.

DOs AND DO NOTs OF EQUIPMENT DECONTAMINATION

DOs:

- DO call the Project Manager or field team leader if unexpected conditions are encountered or at least daily to update them on site work.
- DO manage and collect IDW in accordance with project requirements.
- DO use deionized, distilled or analyte free water that is provided by the laboratory, is certified analyte-free, and/or meets project requirements.
- DO use sufficient amount of decontamination fluids so that the fluid flows over the equipment and runs off.
- DO use new wrapped disposable dedicated sampling equipment when appropriate to minimize the need for decontamination.

DO NOTs:

- DO NOT use an excessive amount of soap during decontamination.
- DO NOT sign anything in the field unless authorized in writing by client. This includes waste disposal documentation, statements, etc.; call PM if this issue arises.

Attachment B: SOP Modifications for PFAS

Due to the pervasive nature of PFAS in various substances routinely used during sampling and the need to mitigate potential cross-contamination or sampling bias to ensure representative data are collected, special care should be taken when sampling for PFAS. The following table highlights the required modifications to this SOP when sampling for PFAS.

PFAS Equipment Decontamination Protocols	
SOP Section Number	Modifications to SOP
1.3	<ul style="list-style-type: none"> • Use only Alconox® or Liquinox® soap; do not use Decon 90. • Use new plastic buckets for wash and rinse water. • Ensure that PFAS-free water is used during the decontamination procedure. • Do not use aluminum foil.
1.5	<p>Always consult the Site-specific Health and Safety Plan prior to conducting field work. The following considerations should be made with regards to decontamination procedures:</p> <ul style="list-style-type: none"> • Tyvek® suits should not be worn. Cotton coveralls may be worn. • Boots and other field clothing containing Gore-Tex™ or other waterproof/resistant material should not be worn. This includes rain gear. Boots made with polyurethane and polyvinyl chloride (PVC) are acceptable. • Food and drink should not be allowed within the decontamination area. Bottled water and hydration drinks (e.g., Gatorade®) may be consumed in the staging area only. • Personnel involved with decontamination should wear a new pair of nitrile gloves after each decontamination procedure when handling equipment to avoid re-contamination. Avoid handling unnecessary items with nitrile gloves. • Do not store on or cover equipment with aluminum foil after decontamination. Use of polyethylene sheeting is acceptable. • Avoid wearing clothing laundered with fabric softeners. • Avoid wearing new clothing (recommended six washings since purchase). Clothing made of cotton is preferred. • Avoid using cosmetics, moisturizers, hand creams, or other related products as part of cleaning/showering the morning of sampling and decontamination field work.
2.2	<ul style="list-style-type: none"> • New nylon or metal bristle brushes should be used for mechanical cleaning methods. • If high-pressure water is used, it must be tested prior to use for presence of PFAS.
2.3	<ul style="list-style-type: none"> • Ensure that PFAS-free water is used during the decontamination procedure.
2.4	<ul style="list-style-type: none"> • Ensure that PFAS-free water is used during the decontamination procedure.

ATTACHMENT B

Chain of Custody Form

APPENDIX B
Community Air Monitoring Plan and Odor Monitoring and
Mitigation Plan

COMMUNITY AIR MONITORING PLAN

The Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area at the Site. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities do not spread contamination off-site through the air.

Community Air Monitoring Plan

Real-time air monitoring for VOCs and observations of particulate levels at the perimeter of the work areas will be completed during intrusive activities. Note that the CAMP will not be implemented during surveying, collection of the sub-slab vapor points, groundwater monitoring well development or groundwater sampling.

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored at the downwind perimeter of each designated work area on a continuous basis. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated daily. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring will continue. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. If total organic vapor levels at the downwind perimeter of the work area persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring will continue. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the work area or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.
3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.
4. All 15-minute readings will be recorded and will be available for State (NYSDEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind locations of the borings at temporary particulate monitoring stations. 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 level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed $150 \mu\text{g}/\text{m}^3$ above the upwind level and provided that no visible dust is migrating from the work area.
2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than $150 \mu\text{g}/\text{m}^3$ above the upwind level, work will be stopped and a re-evaluation of activities will be initiated. Work will be able to be resumed provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within $150 \mu\text{g}/\text{m}^3$ of the upwind level and in preventing visible dust migration.
3. All readings will be recorded and be available for State (NYSDEC and NYSDOH) personnel to review.

ODOR MONITORING AND MITIGATION PLAN

The purpose of this Odor Monitoring and Mitigation Plan is to detail the monitoring and, if necessary, mitigation of odor potentially generated during the RI. Based on the scope of the RI, generation of significant odor is not anticipated. However, work activities will be performed to minimize the potential for generation of odor.

Odor Monitoring

Odor will be monitored within the work area and CAMP stations. 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. Odor or dust complaints from any owner or occupant of an adjacent or nearby property will be immediately addressed and managed by the Environmental Monitor in a manner equivalent to an exceedance of an air monitoring action level.

Odor Mitigation

All necessary means will be employed to prevent on- and off-Site nuisances. These measures may include containerizing drill cuttings immediately and using tarps to cover exposed odorous soil (if encountered). Soil will not be stockpiled as part of the implementation of the RI Work Plan. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: use of chemical odorants in spray or misting systems; and, use of staff to monitor odors in surrounding neighborhoods. Based on the scope of the RI, it is anticipated that any nuisance odors developed during intrusive work can be corrected, without the use of a temporary containment structure equipped with appropriate air venting/filtering systems.

APPENDIX C
Health and Safety Plan

SITE-SPECIFIC HEALTH AND SAFETY PLAN

FOR

REMEDIAL INVESTIGATION

OF

**42-24 ORCHARD STREET SITE
43-01 TO 43-43 QUEENS STREET AND 42-22 TO
42-24 ORCHARD STREET
LONG ISLAND CITY, QUEENS, NY 11101
BLOCK 265, LOTS 1 AND 2**

NYSDEC Brownfield Cleanup Program Site No. TBD

Prepared by:

**TRC Engineers, Inc.
1430 Broadway, 10th Floor
New York, New York 10018**

TRC Project Number 350304

April 2021

DISCLAIMER

STRICT ADHERENCE TO THE HEALTH AND SAFETY GUIDELINES SET FORTH HEREIN WILL REDUCE, BUT NOT ELIMINATE, THE POTENTIAL FOR INJURY AT THESE SITES. THE HEALTH AND SAFETY GUIDELINES IN THIS HEALTH AND SAFETY PLAN WERE PREPARED SPECIFICALLY FOR THIS PROJECT AND SHOULD NOT BE USED ON ANY OTHER SITE OR PROJECT WITHOUT PRIOR RESEARCH AND EVALUATION BY TRAINED HEALTH AND SAFETY SPECIALISTS.

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FIGURES

Figure 1 – Site Location Map

Figure 2 – Proposed Sampling Locations

ATTACHMENTS

Attachment A – Health and Safety Plan Acceptance

Attachment B – Safety Data Sheets for Potential Contaminants of Concern

Attachment C – Hospital Route

Attachment D – Work Care Information

Attachment E – Job-Safety Analysis (JSA)

Attachment F – Daily Pre-Job Safety Briefing Form

Attachment G – Incident Reporting Forms

Attachment H – Observation Form

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C
42-24 ORCHARD STREET SITE
BROOKLYN, NEW YORK 11101

Attachment I – Safe Catch Form

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C
42-24 ORCHARD STREET SITE
BROOKLYN, NEW YORK 11101

1.0 SITE INFORMATION

1.1 Introduction

The following is the Health and Safety Plan (HASP) for Remedial Investigation (RI) activities in connection with the at 42-24 to 42-24 Orchard Street and 43-01 to 43-43 Queens Street, Long Island City, Queens, New York 11101 (referred to as the “Site”). The scope of work is described in the RI Work Plan (RI Work Plan).

The site-specific safety plan was developed from preliminary Site visits and performance of a site assessment. Revisions and/or alterations to this HASP may become necessary as more information becomes available. Any proposed changes to this HASP will be approved by the Health & Safety Coordinator prior to implementation. All on-site personnel are required to read, review and strictly comply with the HASP. It is the responsibility of the Project Manager or designee to ensure that the HASP is implemented and enforced.

1.2 Site Description and History

The Site is located at 42-22 to 42-42 Orchard Street and 43-01 to 43-43 Queens Street, Queens, NY 11101. The legal description of the Site is Block 265, Lots 1, 6, 13, and 23. The Site is currently undergoing a lot merger. The Site location is shown on *Figure 1*. The Site encompasses approximately 82,400 square feet (sf) (+/- 1.89 acres) and is improved with a total of five buildings, as follows:

- Lot 1 is improved with a five (5) story structure with a basement (42-24 Orchard Street) that is occupied by manufacturers (textiles, clothing, and handbags), woodworking companies, commercial tenants and storage spaces with vacant offices; and a one story structure (43-27 to 43-43 Queens Street) that is used for contract storage;
- Lot 6 is improved with a three story structure with a basement (43-15 to 43-25 Queens Street) that is occupied by a food cart/truck storage facility, woodworking company, a textile/clothing manufacturer, and a part supplier;
- Lot 13 is improved with a two-story building with a basement (43-01 Queens Street) occupied by a scrap metal recycling company, and an asphalt-paved valet parking lot; and
- Lot 23 is improved with a two-story slab on grade building (42-22 Orchard Street) occupied by a woodworking company.

TRC conducted environmental due diligence activities at the Site between 2019 and 2021. Based on the results of due diligence activities, elevated concentrations of chlorinated and petroleum related volatile organic compounds (VOCs) are present in soil vapor; petroleum related VOCs, SVOCs, metals, PCBs, and pesticides are present in soil; and petroleum related VOCs, one SVOC, and metals are present in groundwater.

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C
42-24 ORCHARD STREET SITE
BROOKLYN, NEW YORK 11101

2.0 SCOPE OF WORK

Work included in the RI Work Plan includes advancement of soil borings, installation, development, and surveying of permanent monitoring wells, installation of temporary soil vapor points, and collection and laboratory analysis of soil, groundwater, and soil vapor samples.

3.0 EMERGENCY AND TRC CONTACT NUMBERS

Ambulance: **911**

Fire Department: **911**

Police Department: **911 (New York Police Department - 108th Precinct (718) 784-5411)**

Hospital: **Mount Sinai Queens Emergency Room**

Emergency Center No.: **(718) 932-1000**

Hospital Address: **3019 Crescent Street at, 30th Rd, Astoria, Queens, NY 11102**

HOSPITAL DIRECTIONS

NOTE: FOR ANY TYPE OF SERIOUS MEDICAL EMERGENCY, CALL 911 AND REQUEST AN AMBULANCE. NEW YORK CITY STREETS ARE OFTEN CONGESTED DUE TO HEAVY TRAFFIC, CONSTRUCTION AND DOUBLE-PARKED VEHICLES AND IT MAY BE DIFFICULT TO DRIVE TO THE EMERGENCY ROOM.

Refer to **Attachment C** for Hospital Route Directions with maps.

TRC Contacts

1. Project Manager
Name: Kevin Boger, PE
Office/Division: New York City/ECR
Office Phone: 212-221-7822
Cell Phone: 631-617-0087

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C
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2. Certified Industrial Hygienist

Name: Robert Harrington, CIH
Office/Division: New York, NY
Office Phone: 212-221-7822 ext. 108
Cell Phone: 646-988-7156

3. National Safety Director

Name: Mike Glenn
Office/Division: Irvine, CA
Office Phone: 949-727-7347
Cell Phone: 949-697-7418

4. Office Safety Coordinator (OSC)

Name: Emily Ebert
Office/Division: New York City
Office Phone: 347-618-6526
Cell Phone: 908-451-0203

5. Work Care can provide assistance in providing first aid advice and directing an injured worker to non-emergency medical care. WorkCare is a service that provides 24/7 access to an Occupational Healthcare physician or clinician.

Work Care Incident Intervention: 888-449-7787 (refer to **Attachment D**)

6. Human Resource Manager

Name: Suzanne Micallef
Office/Division: Administrative
Office Telephone: 978-656-3628

4.0 HAZARD ASSESSMENT

4.1 Contaminants of Concern

The analytical results of soil samples detected petroleum-related VOCs including (1,2,4-trimethylbenzene, benzene, ethylbenzene, m/p-xylenes, naphthalene, o-xylene, and total xylenes) in one sample at concentrations above comparison criteria. Based on the presence of petroleum odors, staining, and elevated PID readings that were encountered in the soil sample during collection, the petroleum related compounds detected in soil are attributable to an unidentified underground storage tank (UST) or a potential historic release. Acetone was also detected in one (1) soil sample exceeding the Unrestricted Use SCOs and is attributed to laboratory contamination. SVOCs and metals were detected in soil at concentrations exceeding comparison criteria and were attributed to characteristics of fill material at the Site and/or the historic use of the Site as manufacturer (including shoes, furniture, and paper boxes). Lead was detected in one sample collected from the southern portion of the Site above the Toxicity Characteristic Leaching Procedure (TCLP) Regulatory Level. Polychlorinated biphenyls (PCBs) and pesticides were detected in soil samples at concentrations exceeding criteria and may be attributable to characteristics of fill material at the Site.

Petroleum-related VOCs (including 1,2,4-trimethylbenzene, 1,2-dichlorobenzene, 1,3,5-trimethylbenzene, 1,4-dichlorobenzene, ethylbenzene, Isopropylbenzene, m-Xylene & p-Xylene, Naphthalene, N-Propylbenzene, o-Xylene, and total xylenes) and SVOCs (including 1,1'-Biphenyl, Anthracene, Fluoranthene, Fluorene, Naphthalene, Phenanthrene) were detected in one (1) groundwater sample at concentrations exceeding the Class GA Value. Petroleum related compounds detected in groundwater may be attributed to an unidentified UST or a potential historic release. One SVOC, phenol, was detected in one groundwater sample and may be attributable to an unidentified UST or a potential historic release. Metals (iron, magnesium, manganese, selenium, and sodium) were detected in filtered groundwater samples and were attributed to the characteristics of Site soil/fill.

Several chlorinated and petroleum-related VOCs were detected at elevated concentrations in soil vapor samples above screening criteria.

Sample bottles containing hazardous preservatives (e.g., hydrochloric acid, sulfuric acid) will be handled with care. Sample bottles will be checked for leaks and lids tightened. Nitrile chemical resistant gloves and safety glasses will be worn at all times when handling sample bottles.

Isobutylene gas will be used during a short time period at the beginning of each work day to calibrate the photoionization detector (PID). 100 parts per million (ppm) isobutylene will be primarily contained in a Tedlar bag. Any gas that is released to the air will quickly disperse and will not pose a threat to on-Site workers. No monitoring is required for isobutylene.

Similarly, helium gas will be used to confirm an adequate surface seal at each temporary soil vapor sampling point. 99.999% helium will be primarily contained within the annulus of the enclosure of each vapor point. Any gas that is released to the air will quickly disperse and will not pose a threat to on-Site workers. No monitoring is required for helium gas.

Safety Data Sheets (SDS) for compounds of concern are provided in **Attachment B**.

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C
42-24 ORCHARD STREET SITE
BROOKLYN, NEW YORK 11101

4.2 First Aid Procedures for Chemical Exposures

EYE: If any chemicals come in contact with eyes, immediately wash the eyes with large amounts of water, occasionally lifting lower and upper lids. Get medical attention immediately.

BREATH: If person breathes large amounts of any chemicals, remove person to fresh air. If breathing has stopped, perform artificial respiration. Keep affected person warm and rested. Get medical attention as soon as possible.

SKIN: If any chemicals except those listed below come in contact with the skin, immediately wash skin with soap and water. Get medical attention promptly. If chemical penetrates clothing, immediately remove clothing and wash with soap and water.

Soap should not be used if the following chemicals (sample preservatives) potentially encountered at the site contact skin or clothing, **water wash only:**

Hydrochloric acid

SWALLOW: If any chemicals are swallowed get medical attention immediately.

4.3 Biological Hazards

During the course of the project, there is a potential for workers to come into contact with biological hazards, such as animals and their scat.

During Site operations, wild animals such as birds, rats, stray dogs or cats, raccoons, and other rodents and their scat may be encountered. Workers will use discretion and avoid all contact with wild animals and their scat. Avoid areas and habitats inside and outside work areas that are contaminated with scat. If unsafe conditions are noted (e.g., gross accumulations of scat or vermin infestations), work in these areas will be halted and reevaluated.

4.4 Physical Hazards

The physical hazards are anticipated to be low and are outlined in Table A-1 below.

**TABLE A-1
PHYSICAL HAZARDS**

HAZARD TYPE	KNOWN	POTENTIAL
Heat Stress/Cold Stress		X
Severe Weather (lightning, snow, sleet)		X
Excessive Noise	X	
Facility Operations (machinery, structures)		X

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HAZARD TYPE	KNOWN	POTENTIAL
Unstable ground (wet and/or icy areas)		X
Site Operations (Excavation, drilling, hand and power tool use)	X	
Heavy lifting/moving	X	
Hazardous materials use & storage		X
Fire		X
Slips, trips, and falls	X	
Cuts, punctures	X	

TRC personnel can avoid most of the hazards listed above including hand tools, hazardous materials use, slips, trips and falls, and punctures and cuts by remaining alert and performing safe work practices during all site activities. Other proper work practices are outlined below.

1. To avoid falling objects:
 - a. Do not walk or stand under suspended/overhead loads (including scaffolding).
 - b. Be aware of falling objects in the work area.
 - c. Secure overhead objects.
2. When using hand tools:
 - a. Hand tools will meet the manufacturer's safety standards.
 - b. Hand tools will not be altered in any way.
 - c. Makeshift tools will not be used.
 - d. At a minimum, eye protection will be used when working with hand tools.
 - e. Wrenches, including adjustable, pipe, end and socket wrenches, will not be used when jaws are sprung to the point that slippage occurs.
 - f. Impact tools such as drift pins, wedges and chisels, will be kept free of mushroom heads.
 - g. Wooden handles will be free of splinters or cracks and secured tightly to the tool.
3. Slips, Trips and Falls:
 - a. Proper lighting will be maintained at all times.
 - b. Walkways will remain clear and unobstructed at all times.

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c. When possible, cords, hose lines, etc., will be raised to reduce or eliminate trip hazards.

4. Overhead Wires and Underground Utilities:

Prior to intrusive field activities, a geophysical survey consisting of ground-penetrating radar and electromagnetic detection will be conducted., the Site will be visually observed for potential overhead hazards (e.g., tree branches and wires), and drilling locations will be selected that are located at safe distances from the identified hazards and/or underground structures/utilities. If contact with overhead hazards is possible (i.e., ladder, equipment, etc.), one or more of the following will be done:

- Power sources will be disconnected by the utility;
- Power sources will be shielded by the utility; and
- A minimum distance of 10 feet from high voltage overhead utilities will be maintained at all times. The possibility of contacting underground utilities will be minimized by proceeding cautiously and with due diligence.

4.5 Noise

Approved hearing protection will be required in work areas involving heavy equipment, impact tools, drilling, etc. In general, hearing protection should be worn if an individual cannot be heard in a normal speaking voice at a distance of two feet.

4.6 Mechanical Hazards

The mechanical hazards are anticipated to be associated with drilling operations. Mechanical equipment anticipated to be used to advance soil borings includes a hollow-stem auger rig with drive-rods. Drilling operations can present exposure to the following:

- Flying objects (chipped asphalt or concrete, soil) and dust. Measures used to control such exposures will include use of water misting apparatus to keep dust down, or use of a guard installed around the drill to protect against flying objects and dust.
- TRC understands that all subsurface utility lines in the area of drilling were identified by AKRF and its utility mark-out subcontractor and NYC One-Call Center during previous Site investigation work. An update of utility mark-outs by the NYC One-Call Center will be conducted prior to subsurface work.
- Underground utilities present fire, electrocution, burn and explosion hazards. If possible, all lines in the area of drilling will be de-energized, locked-out, and tested before work begins.
- Assembling and disassembling rigs.

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- Perimeter protection in the form of barricades is necessary for the protection of employees and subcontractor personnel and the public. Such protection will meet requirements set forth in 29 CFR 1926, as well as in the New York City Building Code, Article 19.

A Job-Safety Analysis for drilling operations is provided in **Attachment E**.

4.7 Electrical Utility Hazards

TRC will implement the following subsurface utility clearance procedure:

- TRC will review available site plans for work involving activities at or near utilities.
- For environmental drilling, TRC's utility mark-out subcontractor will conduct a geophysical survey around all proposed sampling locations to identify subsurface electric utilities and mark the centerline of underground lines.
- The drilling contractor will notify the NYC One Call Center at (800) 272-4480, in accordance with Code 753, a minimum of 5 working days prior to any drilling on streets and sidewalks.

5.0 AIR MONITORING REQUIREMENTS

An organic vapor photoionization detector (PID) will be used to evaluate airborne levels of VOCs during soil sampling. If ionizable total organic vapors are detected at 5 parts per million (ppm) or higher above ambient background levels in the breathing zone, TRC will follow the response actions, which may include establishing exclusion zones and/or upgrading personal protective equipment (PPE).

If the vapor levels continue to be elevated, other air monitoring devices may be utilized to measure airborne concentrations of specific suspected contaminants of concern (see below) and to assess the need to upgrade the respiratory PPE.

Exposure Limits

The OSHA Permissible Exposure Limit (PEL), for benzene, which will be used to determine the appropriate respiratory protection, is 1 part per million (ppm) over an 8-hour time-weighted average or 5 ppm over 15 minutes. This value is based upon the OSHA PEL for benzene, which, of the VOC constituents of petroleum compounds, has the lowest PEL.

The National Institute for Occupational Safety and Health (NIOSH) considers trichloroethene (TCE) to be a potential occupational carcinogen and the recommended exposure limit (REL) is 25 ppm (as a 10-hour TWA).

Respiratory Protection

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It is unlikely that respiratory protection will be required during implementation of the work plan. If air monitoring measurements indicate that levels of organic vapors have reached 5 ppm, workers will cease work in the area until levels of organic vapors have decreased. If necessary, modifications to work practices will be implemented to reduce or avoid generating elevated levels of organic vapors.

6.0 GENERAL SAFETY REQUIREMENTS

The general safety rules listed below apply to all TRC personnel present at the site.

- A tailgate health and safety meeting will be held with all field team members and subcontractors each day prior to the start of work (refer to Section 12.0).
- Adhere to all requirements of this health and safety plan (HASP).
- Wear protective clothing appropriate for the designated level of protection and decontaminate before entering clean areas when applicable.
- Use safety equipment in accordance with OSHA guidance and labeling instructions.
- Maintain safety equipment in good condition and proper working order and make sure that the equipment is calibrated prior to use.
- Immediately report unsafe acts or conditions to the Project Manager and OSC.
- Eating, drinking, and smoking are prohibited on site, except in designated areas.
- Maintaining a position upwind from intrusive activities is encouraged.
- The emergency shutoff switch should be demonstrated to be working prior to initiating drilling.
- An adequately stocked first-aid kit will be maintained at the work site.

Communication

TRC team-sampling members shall be equipped with cellular telephones. If an emergency occurs, and the team members are not in close proximity to each other, communication will occur via telephone.

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7.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

TRC personnel will use Level D PPE as noted/modified below:

Level D Personal Protective Equipment	
Item	Rationale/Notes
Hardhat	Appropriately rated hard hats will be worn by personnel for protection against overhead hazards, including electrical.
Hearing protection	Hearing protection will be worn by all personnel exposed to more than 85 dB of sound during the workday.
Safety boots	Safety boots will be worn by all personnel during project work described in this HASP and at all times on site.
Eye protection (safety glasses)	Eye protection will be worn when personnel are exposed to flying debris, chemical vapors or particulates. Chemical splash goggles will be worn for protection against chemical gases, vapors or particulates. Safety glasses will be worn for protection against flying objects.
Safety vest	Utilize in areas in or near vehicular traffic of any kind on or off property.
Gloves	Gloves to be changed between samples to avoid cross-contamination. Nitrile chemically resistant gloves will be worn when handling sample bottles.
Kevlar work gloves	As indicated herein, use Cut and Abrasion Resistance Level 4 or Level 5 gloves when necessary for hand protection during field tasks.

A basic first aid kit will be provided by the contractor and readily available on-Site in the event of an emergency.

A fire extinguisher should be present with the drill rig. All personnel working on or around the drill rig should know the location of and how to operate the fire extinguisher. TRC will confirm the location of the first aid kit and fire extinguisher during daily tailgate safety meetings.

8.0 DECONTAMINATION PROCEDURES

8.1 Minimization of Contact with Contaminants

During the completion of all Site activities, personnel should attempt to minimize the degree of contact with contaminated materials. This involves a conscientious effort to keep "clean" during Site activities. All personnel should minimize kneeling, splash generation, and other physical contact with contamination. This may ultimately minimize the degree of decontamination required and the generation of waste materials from Site operations.

8.2 Personnel Decontamination Procedures

The following describes procedures to be employed for personnel decontamination.

PERSONNEL DECONTAMINATION PROCEDURES FOR LEVEL D PROTECTION	
1.	Decontaminate equipment used on-Site (tools, sampling devices and containers, monitoring instruments, radios, clipboards, etc.) with moist towel.
2.	Use boot brush to remove soil from treads of shoes.
2.	Remove PPE and wipe down with moist towel.
3.	Remove gloves and deposit in waste container.
4.	If inner clothing has become contaminated, remove it and place it into a poly bag.
5.	Wash hands and face.

8.3 Decontamination Procedures

All liquids used in the decontamination procedure will be collected, stored, and disposed in accordance with federal, state, and local regulations. Personnel performing this task will wear the proper PPE as prescribed in the table in Section 8.

8.4 Emergency Decontamination

If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination; wrap injured personnel with clean garments/blankets to avoid contaminating other personnel or transporting equipment.

If the person cannot be moved because of the extent of the injury (a back or neck injury) provisions will be made to ensure that emergency response personnel are able to respond to victim without being exposed to potentially hazardous atmospheric conditions. If the potential for inhalation hazards exist, such as with open excavation, this area will be covered with poly to eliminate any potential inhalation hazards. All emergency personnel are to be immediately informed of the injured person's condition, potential contaminants, and provided with all pertinent chemical data.

8.5 Hand Held Equipment Decontamination

Hand held equipment includes all monitoring instruments, samples, hand tools, and field logbooks. To aid in decontamination, monitoring instruments can be sealed in plastic bags or wrapped in polyethylene. This

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will also protect the instruments against contaminants. The instruments will be wiped clean using wipes or paper towels if contamination is visually evident.

Decontamination procedures for sampling equipment, hand tools, etc. will include a moist towel wipe, as appropriate for the Site conditions.

9.0 JOB SAFETY ANALYSIS

A Job Safety Analysis (JSA) is a safety management tool in which the risks or hazards of a specific job in the workplace are identified, and then measures to eliminate or control those hazards are determined and implemented. More specifically, a JSA is a process of systematically evaluating certain jobs, tasks, processes or procedures and eliminating or reducing the risks or hazards to as low as reasonably practical (ALARP) in order to protect workers from injury or illness. The JSA process is documented and the JSA document is used in the workplace or at the job site to guide workers in safe job performance. The JSA document is also a living document that is adjusted as conditions warrant.

The JSA process begins with identification of the potential hazards or risks associated with a particular job. Once the hazards are understood, the consequences of those hazards are then identified, followed by control measures to eliminate or mitigate the hazards.

Please refer to **Attachment E** for the Job Safety Analysis for soil borings and groundwater sampling.

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10.0 REQUIRED PERSONNEL TRAINING

TRC field personnel will have the training outlined below before on-Site work activities:

Project Training Requirements				
(* required for all sites; but minimum recommended)				
Check “A” if training required for everyone, and check “T” if training required for specific task or per notations.				
A	T	SUBJECT	REFERENCE	
			29 CFR 1910	29 CFR 1926 or Other
<input checked="" type="checkbox"/>	<input type="checkbox"/>	HAZWOPER 40 hour	1910.120	1926.65
<input type="checkbox"/>	<input type="checkbox"/>	3-Day HAZWOPER Supervised On-site	1910.120	1926.65
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8-Hour HAZWOPER Refresher	1910.120	1926.65
<input type="checkbox"/>	<input checked="" type="checkbox"/>	8-Hour Supervisor HAZWOPER*	1910.120	1926.65
<input type="checkbox"/>	<input checked="" type="checkbox"/>	First Aid, CPR ¹	1910.151	1926.23,,50
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Hazard Communication (HAZCOM)	1910.1200	1926.59
<input type="checkbox"/>	<input type="checkbox"/>	DOT / IATA Shipping Training	1910.1201	49 CFR 172.704
<input checked="" type="checkbox"/>	<input type="checkbox"/>	TRC Hand Protection Policy	1910.138	TRC Policy ²
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Defensive Driving	N/A	White Paper ³ TRC Manual ⁴
Client-specific training: <input type="checkbox"/> Not Applicable <input type="checkbox"/> Specify				
Client-specific training: <input type="checkbox"/> Not Applicable <input type="checkbox"/> Specify				
Client-specific training: <input type="checkbox"/> Not Applicable <input type="checkbox"/> Specify				
Note: * The on-site Health and Safety Officer shall have OSHA 8-hour supervisor training, in addition to 40-hour HAZWOPER. ¹ Per the TRC Health and Safety Policy and Procedure Manual, each TRC project will have at least one certified CPR/first aid trained person on- Site at all times. All Project Managers, and anyone acting as the on-site Health and Safety Officer, must be current in First Aid/CPR. ² TRC RMD Hand Protection Policy, August 2012 ³ Guidelines for Employers to Reduce Motor Vehicle Crashes (joint white paper by NETS, NHTSA and OSHA) ⁴ TRC Driver and Vehicle Management Policy and Procedure Manual, Rev 1 (April 2012)				

Project training requirements beyond those provided in the above table will require a HASP revision/upgrade or concurrence of the TRC Safety Director or Practice Safety Manager.

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11.0 MEDICAL MONITORING

Medical monitoring will apply routinely to all employees who are or may be exposed to hazardous substances or health hazards at or above the established permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year (40 CFR 1910.120[f][2][i]). Said TRC field personnel will have the medical surveillance outlined in the table below prior to commencing on-site work activities.

Medical Surveillance Required			
*Baseline is minimum recommended.			
	29 CFR 1910	29 CFR 1926 or Other	Notes
<input checked="" type="checkbox"/> HAZWOPER Physical - Baseline	1910.120	1926.65	
<input checked="" type="checkbox"/> HAZWOPER Physical – Annual	1910.120	1926.65	
<input type="checkbox"/> HAZWOPER Physical - Biennial	1910.120	1926.65	
Client-specific drug testing ¹	<input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Specify		
Client-specific medical monitoring ¹	<input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Specify		
Site-specific medical monitoring:	<input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Specify		

Note:

¹ Client required drug testing or medical monitoring should be coordinated through the Project Manager.

TRC has a Drug and Alcohol-Free Workplace Policy. TRC may require employees or subcontractors to be tested upon reasonable suspicion, following accidents or incidents during work activities, or during travel to or from a project Site. Client policies may be stricter in regard to procedures following an accident. Project Managers must be aware of these and inform employees and subcontractors of any additional requirements.

12.0 TAILGATE SAFETY MEETINGS

A tailgate safety meeting will be conducted daily prior to commencement of the work day (see Daily Pre-Job Safety Briefing Form provided in **Attachment F**) or if site conditions change.

Topics covered by the tailgate safety meeting will include, but not be limited to:

- Scope of work and who will conduct each task
- Potential hazards for the scope of work
- weather forecast
- PPE
- Emergency procedures and the route to the medical facility
- Site conditions and features
- Communication guidelines related to stakeholder engagement and visitors

Safety meetings will be held to address modifications to this HASP and any addenda prepared to supplement the HASP. Subcontractors and personnel present at the tailgate safety meeting shall be required to sign an acknowledgement form after each meeting.

13.0 OBSERVATIONS

Note that the Project Manager and/or OSC may notify field staff that their site activities may be the subject of Safety Observation, an integral part of the continuous improvement safety culture promoted at TRC. If subject to an observation, please note the following:

- The Observation will tend to focus on the highest risk activity (as a general example, drilling in a public right-of-way).
- Follow-up observations may be required, depending on prior data collected.
- The observer's preparation before visiting the site will be a review of the HASP, JSAs, client-specific requirements, etc., and a review of the work scope with the Project Manager to ensure the context of the work is well understood in advance.
- Review items may include PPE, body use and positioning, work environment, operating procedures, and tools and equipment (see Attachment H).
- The observation should last between 30 and 60 minutes.

Observations will be documented on the form found in Attachment H. Both positive and negative observations are candidates for documentation and later discussion. The overarching goals are to identify and correct questionable practices, and to identify and promote good, safe and efficient practices. It is a data gathering process that will allow TRC safety specialists to identify root causes for safety issues in both categories to better inform policy decisions.

In addition, TRC may record a Safe Catch which is identification and mitigation of a condition that may have created a hazard if it were not identified. The Safe Catch documentation is provided in Attachment I.

14.0 INCIDENT REPORTING

In case of an incident, TRC personnel must report the incident immediately to their project manager/supervisor and/or OSC, and client's representative, and follow the TRC Incident Response and Reporting Process (see Attachment G). Required forms must be completed within 24 hours following the incident. If the forms are unavailable, the incident shall be reported to the TRC Safety Director (Mike Glenn). Accident/injury/exposure information must be recorded per TRC policy (see Attachment G) and will be the basis of any accident/incident investigations.

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15.0 ACKNOWLEDGEMENT

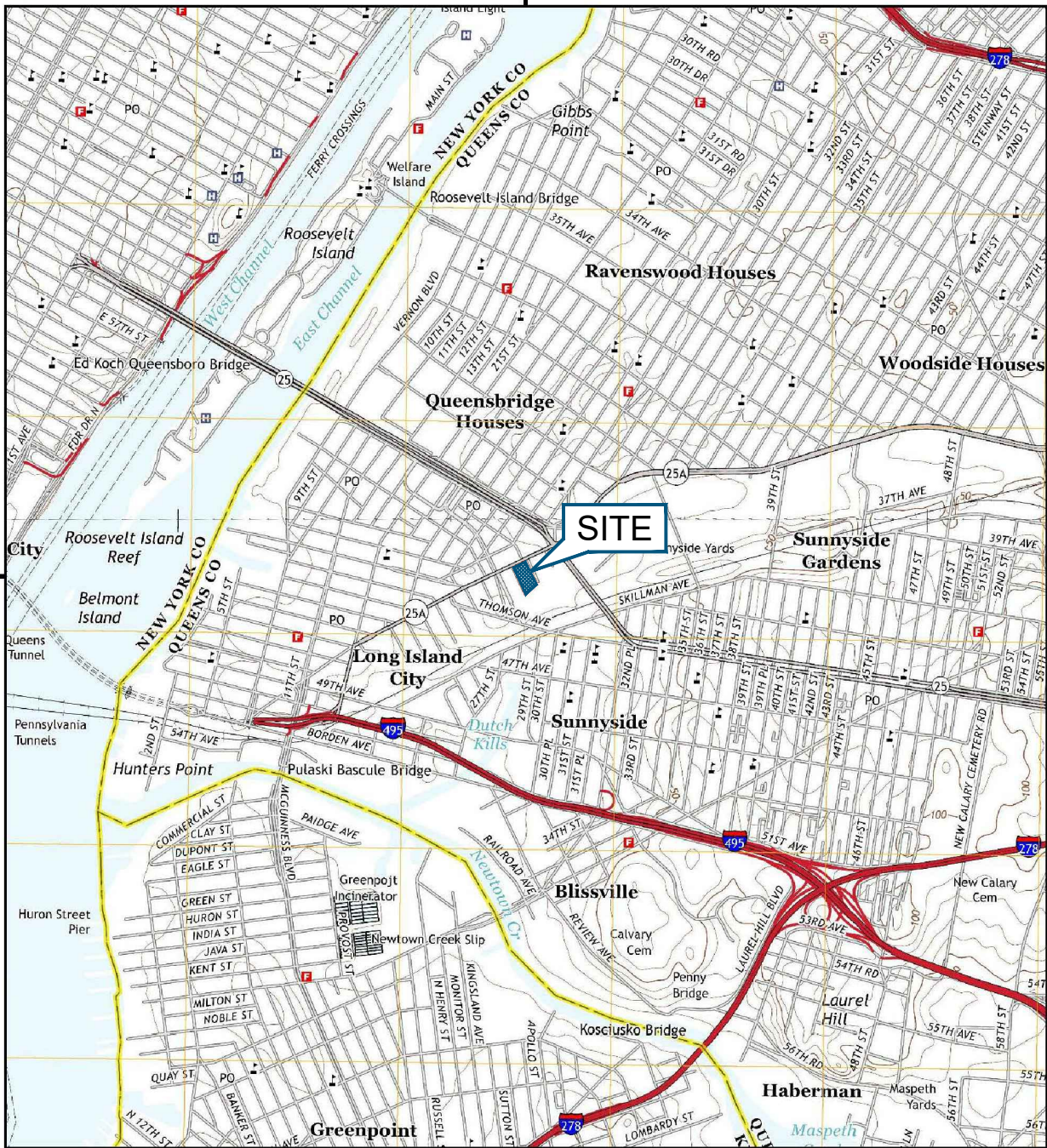
All TRC personnel operating under this HASP must read the HASP and sign the acknowledgment page in Attachment A.

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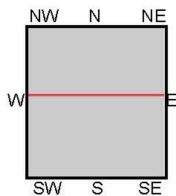
16.0 SUBCONTRACTORS AND HEALTH AND SAFETY PLANNING

TRC personnel must provide the complete HASP to all subcontractors for their reference in advance of the work. Subcontractors must prepare their own site-specific HASP and provide evidence of HASP preparation before the start of site work to ensure that the subcontractor has an understanding of the safety hazards associated with the work that they are performing. Subcontractor HASPs are not required to be included unless contractually/client required, or is so desired by the Project Manager or OSC.

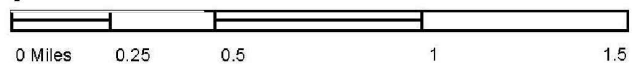
Figures



This report includes information from the following map sheet(s).



TP, Brooklyn, 2013, 7.5-minute
N, Central Park, 2013, 7.5-minute



SITE NAME: 42-22,42-24 Orchard St,43-01,43-43,43-1
ADDRESS: 42-22,42-24 Orchard St,43-01,43-43,43-1
Long Island City, NY 11101



1430 Broadway, 10th Floor
New York, NY 10018
Phone: 212.221.7822
www.TRCompanies.com

PROJECT: **BLDG MANAGEMENT COMPANY, INC.**
43-01 TO 43-43 QUEENS STREET & 42-22 TO 42-24 ORCHARD STREET
BLOCK: 265, LOTS: 1, 6, 13, & 23
LONG ISLAND CITY, QUEENS, NEW YORK 11101


TITLE:

SITE LOCATION MAP

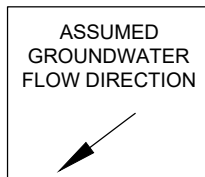
DRAWN BY: H. DELGADO
CHECKED BY: E. EBERT
APPROVED BY: K. BOGER
DATE: APRIL 2021
PROJ. NO.: 350304
FILE: Figure 1 - Site Location Map (42-24).dwg

FIGURE 1



 TRC-SB-##	PROPOSED SOIL BORING LOCATION AND IDENTIFICATION NUMBER
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1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.



FILE NO.: Figure 7 - Prop. Samp. Loc. Plan (42-24).dwg

Attachment A
Health and Safety Plan Acceptance

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C
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ATTACHMENT A

HEALTH AND SAFETY PLAN ACCEPTANCE

SITE: 43-01 to 43-43 Queens Street and 42-22 to 42-24 Orchard Street, Brooklyn, NY

I have received a copy of the Health and Safety Plan for this site and have read, understand and will abide by the procedures set forth in this Health and Safety Plan and any amendments to this plan.

Printed Name

Signature

Date

Attachment B
Safety Data Sheets for Potential Contaminants of Concern

MATERIAL SAFETY DATA SHEET

ALCONOX®

Prepared to U.S. OSHA, CMA, ANSI, Canadian WHMIS, Australian WorkSafe, Japanese Industrial Standard JIS Z 7250:2000, and European Union REACH Regulations



SECTION 1 - PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: **ALCONOX®**
CHEMICAL FAMILY NAME: Detergent.
PRODUCT USE: Critical-cleaning detergent for laboratory, healthcare and industrial applications
U.N. NUMBER: Not Applicable
U.N. DANGEROUS GOODS CLASS: Non-Regulated Material
SUPPLIER/MANUFACTURER'S NAME: Alconox, Inc.
ADDRESS: 30 Glenn St., Suite 309, White Plains, NY 10603. USA
EMERGENCY PHONE: **TOLL-FREE in USA/Canada** 800-255-3924
International calls 813-248-0585
BUSINESS PHONE: 914-948-4040
DATE OF PREPARATION: May 2011
DATE OF LAST REVISION: February 2008

SECTION 2 - HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: This product is a white granular powder with little or no odor. Exposure can be irritating to eyes, respiratory system and skin. It is a non-flammable solid. The Environmental effects of this product have not been investigated.

US DOT SYMBOLS

Non-Regulated

CANADA (WHMIS) SYMBOLS



EUROPEAN and (GHS) Hazard Symbols



Signal Word: **Warning!**

EU LABELING AND CLASSIFICATION:

Classification of the substance or mixture according to Regulation (EC) No1272/2008 Annex 1

EC# 205-633-8 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 268-356-1 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 231-838-7 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 231-767-1 This substance is not classified in the Annex I of Directive 67/548/EEC

EC# 207-638-8 Index# 011-005-00-2

EC# 205-788-1 This substance is not classified in the Annex I of Directive 67/548/EEC

GHS Hazard Classification(s):

Eye Irritant Category 2A

Hazard Statement(s):

H319: Causes serious eye irritation

Precautionary Statement(s):

P260: Do not breath dust/fume/gas/mist/vapors/spray

P264: Wash hands thoroughly after handling

P271: Use only in well ventilated area.

P280: Wear protective gloves/protective clothing/eye protection/face protection/

Hazard Symbol(s):

[Xi] Irritant

MATERIAL SAFETY DATA SHEET

ALCONOX®

Risk Phrases:

R20: Harmful by inhalation
R36/37/38: Irritating to eyes, respiratory system and skin

Safety Phrases:

S8: Keep container dry
S22: Do not breath dust
S24/25: Avoid contact with skin and eyes

HEALTH HAZARDS OR RISKS FROM EXPOSURE:

ACUTE: Exposure to this product may cause irritation of the eyes, respiratory system and skin. Ingestion may cause gastrointestinal irritation including pain, vomiting or diarrhea.

CHRONIC: This product contains an ingredient which may be corrosive.

TARGET ORGANS:

ACUTE: Eye, respiratory System, Skin

CHRONIC: None Known

SECTION 3 - COMPOSITION and INFORMATION ON INGREDIENTS

HAZARDOUS INGREDIENTS:	CAS #	EINECS #	ICSC #	WT %	HAZARD CLASSIFICATION; RISK PHRASES
Sodium Bicarbonate	144-55-8	205-633-8	1044	33 - 43%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	268-356-1	Not Listed	10 – 20%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Tripolyphosphate	7758-29-4	231-838-7	1469	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Tetrasodium Pyrophosphate	7722-88-5	231-767-1	1140	5 - 15%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Sodium Carbonate	497-19-8	207-638-8	1135	1 - 10%	HAZARD CLASSIFICATION: [Xi] Irritant RISK PHRASES: R36
Sodium Alcohol Sulfate	151-21-3	205-788-1	0502	1 – 5%	HAZARD CLASSIFICATION: None RISK PHRASES: None
Balance of other ingredients are non-hazardous or less than 1% in concentration (or 0.1% for carcinogens, reproductive toxins, or respiratory sensitizers).					

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-2004 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR, EU Directives and the Japanese Industrial Standard JIS Z 7250: 2000.

SECTION 4 - FIRST-AID MEASURES

Contaminated individuals of chemical exposure must be taken for medical attention if any adverse effect occurs. Rescuers should be taken for medical attention, if necessary. Take copy of label and MSDS to health professional with contaminated individual.

EYE CONTACT: If product enters the eyes, open eyes while under gentle running water for at least 15 minutes. Seek medical attention if irritation persists.

SKIN CONTACT: Wash skin thoroughly after handling. Seek medical attention if irritation develops and persists. Remove contaminated clothing. Launder before re-use.

INHALATION: If breathing becomes difficult, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Seek medical attention if breathing difficulty continues.

INGESTION: If product is swallowed, call physician or poison control center for most current information. If professional advice is not available, do not induce vomiting. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or who cannot swallow. Seek medical advice. Take a copy of the label and/or MSDS with the victim to the health professional.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Pre-existing skin, or eye problems may be aggravated by prolonged contact.

RECOMMENDATIONS TO PHYSICIANS: Treat symptoms and reduce over-exposure.

MATERIAL SAFETY DATA SHEET

ALCONOX®

SECTION 5 - FIRE-FIGHTING MEASURES

FLASH POINT:

Not Flammable

AUTOIGNITION TEMPERATURE:

Not Applicable

FLAMMABLE LIMITS (in air by volume, %):

Lower (LEL): NA Upper (UEL): NA

FIRE EXTINGUISHING MATERIALS:

As appropriate for surrounding fire. Carbon dioxide, foam, dry chemical, halon, or water spray.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

This product is non-flammable and has no known explosion hazards.

Explosion Sensitivity to Mechanical Impact:

Not Sensitive.

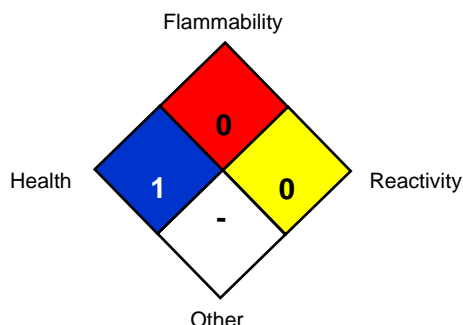
Explosion Sensitivity to Static Discharge:

Not Sensitive



SPECIAL FIRE-FIGHTING PROCEDURES:

Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Isolate materials not yet involved in the fire and protect personnel. Move containers from fire area if this can be done without risk; otherwise, cool with carefully applied water spray. If possible, prevent runoff water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING SYSTEM



HMIS RATING SYSTEM

HAZARDOUS MATERIAL IDENTIFICATION SYSTEM			
HEALTH HAZARD (BLUE)			1
FLAMMABILITY HAZARD (RED)			0
PHYSICAL HAZARD (YELLOW)			0
PROTECTIVE EQUIPMENT			
EYES	RESPIRATORY	HANDS	BODY
	See Sect 8		See Sect 8
For Routine Industrial Use and Handling Applications			

Hazard Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe * = Chronic hazard

SECTION 6 - ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Personnel should be trained for spill response operations.

SPILLS: Contain spill if safe to do so. Prevent entry into drains, sewers, and other waterways. Sweep, shovel or vacuum spilled material and place in an appropriate container for re-use or disposal. Avoid dust generation if possible. Dispose of in accordance with applicable Federal, State, and local procedures (see Section 13, Disposal Considerations).

SECTION 7 - HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting this product ON YOU or IN YOU. Wash thoroughly after handling this product. Do not eat, drink, smoke, or apply cosmetics while handling this product. Avoid breathing dusts generated by this product. Use in a well-ventilated location. Remove contaminated clothing immediately.

STORAGE AND HANDLING PRACTICES: Containers of this product must be properly labeled. Store containers in a cool, dry location. Keep container tightly closed when not in use. Store away from strong acids or oxidizers.

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ALCONOX®

SECTION 8 - EXPOSURE CONTROLS - PERSONAL PROTECTION

EXPOSURE LIMITS/GUIDELINES:

Chemical Name	CAS#	ACGIH TWA	OSHA TWA	SWA
Sodium Bicarbonate	144-55-8	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m ³	5 mg/m ³	5 mg/m ³
Sodium Carbonate	497-19-8	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m ³ Total Dust	15 mg/m ³ Total Dust	10 mg/m ³ Total Dust

Currently, International exposure limits are not established for the components of this product. Please check with competent authority in each country for the most recent limits in place.

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided below. Use local exhaust ventilation to control airborne dust. Ensure eyewash/safety shower stations are available near areas where this product is used.

The following information on appropriate Personal Protective Equipment is provided to assist employers in complying with OSHA regulations found in 29 CFR Subpart I (beginning at 1910.132) or equivalent standard of Canada, or standards of EU member states (including EN 149 for respiratory PPE, and EN 166 for face/eye protection), and those of Japan. Please reference applicable regulations and standards for relevant details.

RESPIRATORY PROTECTION: Based on test data, exposure limits should not be exceeded under normal use conditions when using Alconox Detergent. Maintain airborne contaminant concentrations below guidelines listed above, if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134), equivalent U.S. State standards, Canadian CSA Standard Z94.4-93, the European Standard EN149, or EU member states.

EYE PROTECTION: Safety glasses. If necessary, refer to U.S. OSHA 29 CFR 1910.133 or appropriate Canadian Standards.

HAND PROTECTION: Use chemical resistant gloves to prevent skin contact.. If necessary, refer to U.S. OSHA 29 CFR 1910.138 or appropriate Standards of Canada.

BODY PROTECTION: Use body protection appropriate to prevent contact (e.g. lab coat, overalls). If necessary, refer to appropriate Standards of Canada, or appropriate Standards of the EU, Australian Standards, or relevant Japanese Standards.

SECTION 9 - PHYSICAL and CHEMICAL PROPERTIES

PHYSICAL STATE:	Solid
APPEARANCE & ODOR:	White granular powder with little or no odor.
ODOR THRESHOLD (PPM):	Not Available
VAPOR PRESSURE (mmHg):	Not Applicable
VAPOR DENSITY (AIR=1):	Not Applicable.
BY WEIGHT:	Not Available
EVAPORATION RATE (nBuAc = 1):	Not Applicable.
BOILING POINT (C°):	Not Applicable.
FREEZING POINT (C°):	Not Applicable.
pH:	9.5 (1% aqueous solution)
SPECIFIC GRAVITY 20°C: (WATER =1)	0.85 – 1.1
SOLUBILITY IN WATER (%)	>10% w/w
COEFFICIENT OF WATER/OIL DIST.:	Not Available
VOC:	None
CHEMICAL FAMILY:	Detergent

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SECTION 10 - STABILITY and REACTIVITY

STABILITY: Product is stable

DECOMPOSITION PRODUCTS: When heated to decomposition this product produces Oxides of carbon (COx)

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Strong acids and strong oxidizing agents.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Contact with incompatible materials and dust generation.

SECTION 11 - TOXICOLOGICAL INFORMATION

TOXICITY DATA: Toxicity data is available for mixture:

CAS# 497-19-8 LD50 Oral (Rat)	4090 mg/kg
CAS# 497-19-8 LD50 Oral (Mouse)	6600 mg/kg
CAS# 497-19-8 LC50 Inhalation (Rat)	2300 mg/m ³ 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m ³ 2H
CAS# 7758-29-4 LD50 Oral (Rat)	3120 mg/kg
CAS# 7758-29-4 LD50 Oral (Mouse)	3100 mg/kg
CAS# 7722-88-5 LD50 Oral (Rat)	4000 mg/kg

SUSPECTED CANCER AGENT: None of the ingredients are found on the following lists: FEDERAL OSHA Z LIST, NTP, CAL/OSHA, IARC and therefore is not considered to be, nor suspected to be a cancer-causing agent by these agencies.

IRRITANCY OF PRODUCT: Contact with this product can be irritating to exposed skin, eyes and respiratory system.

SENSITIZATION OF PRODUCT: This product is not considered a sensitizer.

REPRODUCTIVE TOXICITY INFORMATION: No information concerning the effects of this product and its components on the human reproductive system.

SECTION 12 - ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: No Data available at this time.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: No evidence is currently available on this product's effects on plants or animals.

EFFECT OF CHEMICAL ON AQUATIC LIFE: No evidence is currently available on this product's effects on aquatic life.

SECTION 13 - DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations, those of Canada, Australia, EU Member States and Japan.

SECTION 14 - TRANSPORTATION INFORMATION

US DOT; IATA; IMO; ADR:

THIS PRODUCT IS NOT HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Non-Regulated Material

HAZARD CLASS NUMBER and DESCRIPTION: Not Applicable

UN IDENTIFICATION NUMBER: Not Applicable

PACKING GROUP: Not Applicable.

DOT LABEL(S) REQUIRED: Not Applicable

NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (2004): Not Applicable

MARINE POLLUTANT: None of the ingredients are classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B)

U.S. DEPARTMENT OF TRANSPORTATION (DOT) SHIPPING REGULATIONS:

This product is not classified as dangerous goods, per U.S. DOT regulations, under 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS:

This product is not classified as Dangerous Goods, per regulations of Transport Canada.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA):

This product is not classified as Dangerous Goods, by rules of IATA:

INTERNATIONAL MARITIME ORGANIZATION (IMO) DESIGNATION:

This product is not classified as Dangerous Goods by the International Maritime Organization.

EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE OF DANGEROUS GOODS BY ROAD (ADR):

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This product is not classified by the United Nations Economic Commission for Europe to be dangerous goods.

SECTION 15 - REGULATORY INFORMATION

UNITED STATES REGULATIONS

SARA REPORTING REQUIREMENTS: This product 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: None

TSCA: All components in this product are listed on the US Toxic Substances Control Act (TSCA) inventory of chemicals.

SARA 311/312:

Acute Health: Yes Chronic Health: No Fire: No Reactivity: No

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for this product. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lb (4,540 kg) may apply, per 40 CFR 370.20.

U.S. CERCLA REPORTABLE QUANTITY (RQ): None

CALIFORNIA SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT (PROPOSITION 65): None of the ingredients are on the California Proposition 65 lists.

CANADIAN REGULATIONS:

CANADIAN DSL/NDL INVENTORY STATUS: All of the components of this product are on the DSL Inventory

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: No component of this product is on the CEPA First Priorities Substance Lists.

CANADIAN WHMIS CLASSIFICATION and SYMBOLS: This product is categorized as a Controlled Product, Hazard Class D2B as per the Controlled Product Regulations

EUROPEAN ECONOMIC COMMUNITY INFORMATION:

EU LABELING AND CLASSIFICATION:

Classification of the mixture according to Regulation (EC) No1272/2008. See section 2 for details.

AUSTRALIAN INFORMATION FOR PRODUCT:

AUSTRALIAN INVENTORY OF CHEMICAL SUBSTANCES (AICS) STATUS: All components of this product are listed on the AICS.

STANDARD FOR THE UNIFORM SCHEDULING OF DRUGS AND POISONS: Not applicable.

JAPANESE INFORMATION FOR PRODUCT:

JAPANESE MINISTER OF INTERNATIONAL TRADE AND INDUSTRY (MITI) STATUS: The components of this product are not listed as Class I Specified Chemical Substances, Class II Specified Chemical Substances, or Designated Chemical Substances by the Japanese MITI.

INTERNATIONAL CHEMICAL INVENTORIES:

Listing of the components on individual country Chemical Inventories is as follows:

Asia-Pac:	Listed
Australian Inventory of Chemical Substances (AICS):	Listed
Korean Existing Chemicals List (ECL):	Listed
Japanese Existing National Inventory of Chemical Substances (ENCS):	Listed
Philippines Inventory of Chemicals and Chemical Substances (PICCS):	Listed
Swiss Giftlist of Toxic Substances:	Listed
U.S. TSCA:	Listed

SECTION 16 - OTHER INFORMATION

PREPARED BY: Paul Eigbrett Global Safety Management, 10006 Cross Creek Blvd. Suite 440, Tampa, FL 33647

MATERIAL SAFETY DATA SHEET

ALCONOX®

Disclaimer: To the best of Alconox, Inc. knowledge, the information contained herein is reliable and accurate as of this date; however, accuracy, suitability or completeness is not guaranteed and no warranties of any type either express or implied are provided. The information contained herein relates only to this specific product.

ANNEX:

IDENTIFIED USES OF ALCONOX® AND DIRECTIONS FOR USE

Used to clean: Healthcare instruments, laboratory ware, vacuum equipment, tissue culture ware, personal protective equipment, sampling apparatus, catheters, tubing, pipes, radioactive contaminated articles, optical parts, electronic components, pharmaceutical apparatus, cosmetics manufacturing equipment, metal castings, forgings and stampings, industrial parts, tanks and reactors. Authorized by USDA for use in federally inspected meat and poultry plants. Passes inhibitory residue test for water analysis. FDA certified.

Used to remove: Soil, grit, grime, buffing compound, slime, grease, oils, blood, tissue, salts, deposits, particulates, solvents, chemicals, radioisotopes, radioactive contaminations, silicon oils, mold release agents.

Surfaces cleaned: Corrosion inhibited formulation recommended for glass, metal, stainless steel, porcelain, ceramic, plastic, rubber and fiberglass. Can be used on soft metals such as copper, aluminum, zinc and magnesium if rinsed promptly. Corrosion testing may be advisable.

Cleaning method: Soak, brush, sponge, cloth, ultrasonic, flow through clean-inplace. Will foam—not for spray or machine use.

Directions: Make a fresh 1% solution (2 1/2 Tbsp. per gal., 1 1/4 oz. per gal. or 10 grams per liter) in cold, warm, or hot water. If available use warm water. Use cold water for blood stains. For difficult soils, raise water temperature and use more detergent. Clean by soak, circulate, wipe, or ultrasonic method. Not for spray machines, will foam. For nonabrasive scouring, make paste. Use 2% solution to soak frozen stopcocks. To remove silver tarnish, soak in 1% solution in aluminum container. RINSE THOROUGHLY—preferably with running water. For critical cleaning, do final or all rinsing in distilled, deionized, or purified water. For food contact surfaces, rinse with potable water. Used on a wide range of glass, ceramic, plastic, and metal surfaces. Corrosion testing may be advisable.

SAFETY DATA SHEET



Benzene

Section 1. Identification

GHS product identifier	: Benzene
Chemical name	: benzene
Other means of identification	: benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol
Product use	: Synthetic/Analytical chemistry.
Synonym	: benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol
SDS #	: 001062
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
Emergency telephone number (with hours of operation)	: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: FLAMMABLE LIQUIDS - Category 2 SKIN CORROSION/IRRITATION - Category 2 SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 2 GERM CELL MUTAGENICITY - Category 1B CARCINOGENICITY - Category 1 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (bone marrow) - Category 1

GHS label elements

Hazard pictograms	:   
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Signal word	: Danger
Hazard statements	: Highly flammable liquid and vapor. May form explosive mixtures with air. Causes serious eye irritation. Causes skin irritation. May cause genetic defects. May cause cancer. Causes damage to organs through prolonged or repeated exposure. (bone marrow)

Precautionary statements

General	: Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.
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Date of issue/Date of revision	: 4/26/2015.	Date of previous issue	: 10/16/2014.	Version	: 0.03	1/14
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Section 2. Hazards identification

- Prevention** : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Wear protective gloves. Wear eye or face protection. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Do not breathe vapor. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling.
- Response** : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF SWALLOWED: Call a POISON CENTER or physician if you feel unwell. Rinse mouth. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.
- Storage** : Store locked up. Store in a well-ventilated place. Keep cool.
- Disposal** : Dispose of contents and container in accordance with all local, regional, national and international regulations.
- Hazards not otherwise classified** : None known.

Section 3. Composition/information on ingredients

- Substance/mixture** : Substance
- Chemical name** : benzene
- Other means of identification** : benzene, purebenzol; cyclohexatriene; phenyl hydride; phene; coal naphtha; pyrobenzol

CAS number/other identifiers

- CAS number** : 71-43-2
- Product code** : 001062

Ingredient name	%	CAS number
benzene	100	71-43-2

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Section 4. First aid measures

- Skin contact** : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention. If necessary, call a poison center or physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : Causes serious eye irritation.
- Inhalation** : No known significant effects or critical hazards.
- Skin contact** : Causes skin irritation.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : Harmful if swallowed. Irritating to mouth, throat and stomach.

Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following:
pain or irritation
watering
redness
- Inhalation** : No specific data.
- Skin contact** : Adverse symptoms may include the following:
irritation
redness
- Ingestion** : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : 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. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use dry chemical, CO₂, water spray (fog) or foam.

Unsuitable extinguishing media : Do not use water jet.

Specific hazards arising from the chemical : Highly flammable liquid and vapor. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not ingest. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
benzene	<p>ACGIH TLV (United States, 3/2012). Absorbed through skin. STEL: 8 mg/m³ 15 minutes. STEL: 2.5 ppm 15 minutes. TWA: 1.6 mg/m³ 8 hours. TWA: 0.5 ppm 8 hours.</p> <p>NIOSH REL (United States, 1/2013). STEL: 1 ppm 15 minutes. TWA: 0.1 ppm 10 hours.</p> <p>OSHA PEL (United States, 6/2010). STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours.</p> <p>OSHA PEL 1989 (United States, 3/1989). STEL: 5 ppm 15 minutes. TWA: 1 ppm 8 hours.</p> <p>OSHA PEL Z2 (United States, 11/2006). AMP: 50 ppm 10 minutes. CEIL: 25 ppm TWA: 10 ppm 8 hours.</p>

Section 8. Exposure controls/personal protection

Appropriate engineering controls	: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.
Environmental exposure controls	: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.
<u>Individual protection measures</u>	
Hygiene measures	: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
Eye/face protection	: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.
<u>Skin protection</u>	
Hand protection	: Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
Body protection	: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.
Other skin protection	: Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection	: 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.

Section 9. Physical and chemical properties

Appearance

Physical state	: Liquid. [Watery liquid.]
Color	: Colorless. Yellowish.
Molecular weight	: 78.12 g/mole
Molecular formula	: C ₆ H ₆
Boiling/condensation point	: 80.09°C (176.2°F)
Melting/freezing point	: 5.49°C (41.9°F)
Critical temperature	: 288.95°C (552.1°F)
Odor	: Characteristic.
Odor threshold	: Not available.

Section 9. Physical and chemical properties

pH	: Not available.
Flash point	: Closed cup: -11°C (12.2°F)
Burning time	: Not applicable.
Burning rate	: Not applicable.
Evaporation rate	: 3.5 (butyl acetate = 1)
Flammability (solid, gas)	: Not available.
Lower and upper explosive (flammable) limits	: Lower: 1.2% Upper: 7.8%
Vapor pressure	: 10 kPa (75.006094245 mm Hg) [room temperature]
Vapor density	: 2.7 (Air = 1)
Specific Volume (ft³/lb)	: 1.1403
Gas Density (lb/ft³)	: 0.877 (20°C / 68 to °F)
Relative density	: 0.88
Solubility	: Not available.
Solubility in water	: 1.88 g/l
Partition coefficient: n-octanol/water	: 2.13
Auto-ignition temperature	: 498°C (928.4°F)
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Dynamic (room temperature): 0.604 mPa·s (0.604 cP)

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.
Incompatibility with various substances	: Highly reactive or incompatible with the following materials: oxidizing materials.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
benzene	LC50 Inhalation Gas. LD50 Oral	Rat Rat	10000 ppm 930 mg/kg	7 hours -

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
benzene	Eyes - Moderate irritant	Rabbit	-	88 milligrams	-
	Eyes - Severe irritant	Rabbit	-	24 hours 2 milligrams	-
	Skin - Mild irritant	Rat	-	8 hours 60 microliters	-
	Skin - Mild irritant	Rabbit	-	24 hours 15 milligrams	-
	Skin - Moderate irritant	Rabbit	-	24 hours 20 milligrams	-

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
benzene	+	1	Known to be a human carcinogen.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
benzene	Category 1	Not determined	bone marrow

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : No known significant effects or critical hazards.

Section 11. Toxicological information

- Skin contact** : Causes skin irritation.
- Ingestion** : Harmful if swallowed. Irritating to mouth, throat and stomach.

Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : Adverse symptoms may include the following:
pain or irritation
watering
redness
- Inhalation** : No specific data.
- Skin contact** : Adverse symptoms may include the following:
irritation
redness
- Ingestion** : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Long term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Potential chronic health effects

Not available.

- General** : Causes damage to organs through prolonged or repeated exposure.
- Carcinogenicity** : May cause cancer. Risk of cancer depends on duration and level of exposure.
- Mutagenicity** : May cause genetic defects.
- Teratogenicity** : No known significant effects or critical hazards.
- Developmental effects** : No known significant effects or critical hazards.
- Fertility effects** : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Section 12. Ecological information

Product/ingredient name	LogP _{ow}	BCF	Potential
benzene	2.13	11	low

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.






Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Benzene (I,T)	71-43-2	Listed	U019

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1114	UN1114	UN114	UN1114	UN1114
UN proper shipping name	BENZENE	BENZENE	BENZENE	BENZENE	BENZENE
Transport hazard class(es)	3 	3 	3 	3 	3 
Packing group	II	II	II	II	II
Environment	No.	No.	No.	No.	No.
Additional information	Reportable quantity 10 lbs / 4.54 kg [1.3675 gal / 5.1767 L] Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.	Explosive Limit and Limited Quantity Index 1 Passenger Carrying Road or Rail Index 5	-	-	Passenger and Cargo Aircraft Quantity limitation: 5 L Cargo Aircraft Only Quantity limitation: 60 L Limited Quantities - Passenger Aircraft Quantity limitation: 1 L

Date of issue/Date of revision : 4/26/2015. Date of previous issue : 10/16/2014. Version : 0.03 10/14

Section 14. Transport information

	<p>Limited quantity Yes.</p> <p>Packaging instruction Passenger aircraft Quantity limitation: 5 L</p> <p>Cargo aircraft Quantity limitation: 60 L</p> <p>Special provisions IB2, T4, TP1</p>				
--	---	--	--	--	--

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

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption:** Not determined
United States inventory (TSCA 8b): This material is listed or exempted.
Clean Water Act (CWA) 307: benzene
Clean Water Act (CWA) 311: benzene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Fire hazard
Immediate (acute) health hazard
Delayed (chronic) health hazard

Composition/information on ingredients

Section 15. Regulatory information

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
benzene	100	Yes.	No.	No.	Yes.	Yes.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	benzene	71-43-2	100
Supplier notification	benzene	71-43-2	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

- Massachusetts** : This material is listed.
New York : This material is listed.
New Jersey : This material is listed.
Pennsylvania : This material is listed.

California Prop. 65

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

Ingredient name	Cancer	Reproductive	No significant risk level	Maximum acceptable dosage level
benzene	Yes.	Yes.	6.4 µg/day (ingestion) 13 µg/day (inhalation)	24 µg/day (ingestion) 49 µg/day (inhalation)

- Canada inventory** : This material is listed or exempted.

International regulations

- International lists** : **Australia inventory (AICS)**: This material is listed or exempted.
China inventory (IECSC): This material is listed or exempted.
Japan inventory: This material is listed or exempted.
Korea inventory: This material is listed or exempted.
Malaysia Inventory (EHS Register): Not determined.
New Zealand Inventory of Chemicals (NZIoC): This material is listed or exempted.
Philippines inventory (PICCS): This material is listed or exempted.
Taiwan inventory (CSNN): Not determined.

- Chemical Weapons Convention List Schedule I Chemicals** : Not listed

- Chemical Weapons Convention List Schedule II Chemicals** : Not listed

- Chemical Weapons Convention List Schedule III Chemicals** : Not listed

Canada

Section 15. Regulatory information

WHMIS (Canada) : Class B-2: Flammable liquid
 Class D-2A: Material causing other toxic effects (Very toxic).
 Class D-2B: Material causing other toxic effects (Toxic).
CEPA Toxic substances: This material is listed.
Canadian ARET: This material is not listed.
Canadian NPRI: This material is 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

Canada Label requirements : Class B-2: Flammable liquid
 Class D-2A: Material causing other toxic effects (Very toxic).
 Class D-2B: Material causing other toxic effects (Toxic).

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

Health	*	2
Flammability		3
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on SDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

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



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

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Version : 0.03

Section 16. Other information

Key to abbreviations

- : ATE = Acute Toxicity Estimate
- BCF = Bioconcentration Factor
- GHS = Globally Harmonized System of Classification and Labelling of Chemicals
- IATA = International Air Transport Association
- IBC = Intermediate Bulk Container
- IMDG = International Maritime Dangerous Goods
- LogPow = logarithm of the octanol/water partition coefficient
- MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
- UN = United Nations
- ACGIH – American Conference of Governmental Industrial Hygienists
- AIHA – American Industrial Hygiene Association
- CAS – Chemical Abstract Services
- CEPA – Canadian Environmental Protection Act
- CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
- CFR – United States Code of Federal Regulations
- CPR – Controlled Products Regulations
- DSL – Domestic Substances List
- GWP – Global Warming Potential
- IARC – International Agency for Research on Cancer
- ICAO – International Civil Aviation Organisation
- Inh – Inhalation
- LC – Lethal concentration
- LD – Lethal dosage
- NDSL – Non-Domestic Substances List
- NIOSH – National Institute for Occupational Safety and Health
- TDG – Canadian Transportation of Dangerous Goods Act and Regulations
- TLV – Threshold Limit Value
- TSCA – Toxic Substances Control Act
- WEEL – Workplace Environmental Exposure Level
- WHMIS – Canadian Workplace Hazardous Material Information System

References

- : Not available.

 Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Safety data sheet
according to 1907/2006/EC, Article 31

Page 1/9

Printing date 17.08.2018
Revision: 17.08.2018
Version number 7

SECTION 1: Identification of the substance/mixture and of the company/undertaking

- **1.1 Product identifier**
- **Trade name:** trichloromethane
- **Article number:** A3691
- **CAS Number:**
67-66-3
- **EC number:**
200-663-8
- **Index number:**
602-006-00-4
- **Registration number** 01-2119486657-20-XXXX
- **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.
- **Application of the substance / the mixture**
Chemical analytics
Solvents
Laboratory chemical
- **1.3 Details of the supplier of the safety data sheet**
- **Manufacturer/Supplier:**
AppliChem GmbH
Ottoweg 4
D-64291 Darmstadt
Tel.: +49 (0)6151 93570
Fax.: +49 (0)6151 935711
msds@applichem.com
- **Further information obtainable from:** Dept. Compliance
- **1.4 Emergency telephone number:** +49(0)6151 93570 (Inside normal business hours)

SECTION 2: Hazards identification

- **2.1 Classification of the substance or mixture**
- **Classification according to Regulation (EC) No 1272/2008**
Acute Tox. 4 H302 Harmful if swallowed.
Acute Tox. 3 H331 Toxic if inhaled.
Skin Irrit. 2 H315 Causes skin irritation.
Eye Irrit. 2 H319 Causes serious eye irritation.
Carc. 2 H351 Suspected of causing cancer.
Repr. 2 H361d Suspected of damaging the unborn child.
STOT RE 1 H372 Causes damage to organs through prolonged or repeated exposure.

- **2.2 Label elements**
- **Labelling according to Regulation (EC) No 1272/2008**
The substance is classified and labelled according to the CLP regulation.
- **Hazard pictograms**



GHS06 GHS08

- **Signal word** Danger

(Contd. on page 2)

Trade name: trichloromethane

(Contd. of page 1)

• **Hazard statements**

- H302 Harmful if swallowed.
- H331 Toxic if inhaled.
- H315 Causes skin irritation.
- H319 Causes serious eye irritation.
- H351 Suspected of causing cancer.
- H361d Suspected of damaging the unborn child.
- H372 Causes damage to organs through prolonged or repeated exposure.

• **Precautionary statements**

- P260 Do not breathe dust/fume/gas/mist/vapours/spray.
- P280 Wear protective gloves/protective clothing/eye protection/face protection.
- P301+P312 IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell.
- P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- P405 Store locked up.
- P501 Dispose of contents/container in accordance with local/regional/national/international regulations.

• **2.3 Other hazards**

• **Results of PBT and vPvB assessment**

- **PBT:** Not applicable.
- **vPvB:** Not applicable.

SECTION 3: Composition/information on ingredients

• **3.1 Chemical characterisation: Substances**

- **CAS No. Description**
67-66-3 trichloromethane
- **Identification number(s)**
- **EC number:** 200-663-8
- **Index number:** 602-006-00-4

SECTION 4: First aid measures

• **4.1 Description of first aid measures**

• **General information:**

Symptoms of poisoning may even occur after several hours; therefore medical observation for at least 48 hours after the accident.

Remove breathing equipment only after contaminated clothing have been completely removed.

In case of irregular breathing or respiratory arrest provide artificial respiration.

Involve doctor immediately.

• **After inhalation:**

Supply fresh air or oxygen; call for doctor.

In case of unconsciousness place patient stably in side position for transportation.

If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel.

• **After skin contact:**

Call a doctor immediately.

Immediately wash with water and soap and rinse thoroughly.

Immediately remove any clothing soiled by the product.

• **After eye contact:**

Rinse opened eye for several minutes under running water.

Call a doctor immediately.

• **After swallowing:**

Do not induce vomiting; call for medical help immediately.

Risk of aspiration!

Subsequently administer:

activated charcoal (20 - 40 g in 10 % slurry)

(Contd. on page 3)

Trade name: trichloromethane

(Contd. of page 2)

- **4.2 Most important symptoms and effects, both acute and delayed**
No further relevant information available.
- **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

SECTION 5: Firefighting measures

- **5.1 Extinguishing media**
- **Suitable extinguishing agents:** Use fire extinguishing methods suitable to surrounding conditions.
- **5.2 Special hazards arising from the substance or mixture**
Hydrogen chloride (HCl)
Phosgene gas
carbon oxides (CO, CO₂).
Non-combustible.
- **5.3 Advice for firefighters**
- **Protective equipment:**
Mouth respiratory protective device.
Wear self-contained respiratory protective device.
- **Additional information**
Dispose of fire debris and contaminated fire fighting water in accordance with official regulations.
Contain escaping vapours with water.

SECTION 6: Accidental release measures

- **6.1 Personal precautions, protective equipment and emergency procedures**
Avoid substance contact.
- **6.2 Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
- **6.3 Methods and material for containment and cleaning up:**
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Dispose contaminated material as waste according to item 13.
Ensure adequate ventilation.
Clean up affected area.
- **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

SECTION 7: Handling and storage

- **7.1 Precautions for safe handling**
Ensure good ventilation/exhaustion at the workplace.
Open and handle receptacle with care.
Prevent formation of aerosols.
- **Information about fire - and explosion protection:**
Keep respiratory protective device available.
The product is not flammable.
- **7.2 Conditions for safe storage, including any incompatibilities**
- **Storage:**
- **Requirements to be met by storerooms and receptacles:** No special requirements.
- **Information about storage in one common storage facility:** Not required.
- **Further information about storage conditions:**
Keep container tightly sealed.
Open receptacle only under localised extractor facilities.
Store receptacle in a well ventilated area.
Store under lock and key and with access restricted to technical experts or their assistants only.
- **Recommended storage temperature:** Room Temperature

(Contd. on page 4)

Trade name: trichloromethane

(Contd. of page 3)

- **Storage class:** 6.1 D
- **7.3 Specific end use(s)** No further relevant information available.

SECTION 8: Exposure controls/personal protection

- **Additional information about design of technical facilities:** No further data; see item 7.
- **8.1 Control parameters**

• **Ingredients with limit values that require monitoring at the workplace:**

67-66-3 trichloromethane

WEL	Long-term value: 9.9 mg/m ³ , 2 ppm
Sk	

• **DNELs**

Dermal	Long-term - systemic effects, worker	0.94 mg/kg
Inhalative	Acute - systemic effects, worker	333 mg/m ³
	Long-term - systemic effects, worker	2.5 mg/m ³
	Long-term - local effects, worker	2.5 mg/m ³
	Long-term - systemic effects, general population	0.18 mg/m ³

• **PNECs**

Aquatic compartment - freshwater	0.146 mg/L
Aquatic compartment - marine water	0.015 mg/L
Aquatic compartment - water, intermittent releases	0.133 mg/L
Aquatic compartment - sediment in freshwater	0.45 mg/kg
Aquatic compartment - sediment in marine water	0.09 mg/kg
Terrestrial compartment - soil	0.56 mg/kg
Sewage treatment plant	0.048 mg/L

- **Additional information:** The lists valid during the making were used as basis.

• **8.2 Exposure controls**

• **Personal protective equipment:**

• **General protective and hygienic measures:**

Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing
Wash hands before breaks and at the end of work.
Store protective clothing separately.
Avoid contact with the eyes and skin.

• **Respiratory protection:**

In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use self-contained respiratory protective device.
Filter AX

• **Protection of hands:**



Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

• **Material of gloves**

The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

• **Penetration time of glove material**

The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

(Contd. on page 5)

Trade name: trichloromethane

(Contd. of page 4)

- **For the permanent contact gloves made of the following materials are suitable:**
Recommended thickness of the material: ≥ 0.7 mm
Fluorocarbon rubber (Viton)
Value for the permeation: Level ≥ 480 min
- **As protection from splashes gloves made of the following materials are suitable:**
Recommended thickness of the material: ≥ 0.7 mm
Butyl rubber, BR
Value for the permeation: Level ≥ 10 min
- **Eye protection:**



Tightly sealed goggles

- **Body protection:**
Use protective suit.
Protective clothing should be selected specifically for the working place, depending on concentration and quantity of the hazardous substances handled.

SECTION 9: Physical and chemical properties

- **9.1 Information on basic physical and chemical properties**
- **General Information**
- **Appearance:**
 - Form: Fluid
 - Colour: Colourless
- **Odour:** Sweetish
- **Odour threshold:** Not determined.
- **pH-value:** Not determined.
- **Change in condition**
 - Melting point/freezing point: -63 °C
 - Initial boiling point and boiling range: 61 °C
- **Flash point:** Not applicable.
- **Flammability (solid, gas):** Not applicable.
- **Decomposition temperature:** Not determined.
- **Auto-ignition temperature:** Not determined.
- **Explosive properties:** Product does not present an explosion hazard.
- **Explosion limits:**
 - Lower: Not determined.
 - Upper: Not determined.
- **Vapour pressure at 20 °C:** 211 hPa
- **Density at 20 °C:** 1.48 g/cm³
- **Relative density** Not determined.
- **Vapour density** Not determined.
- **Evaporation rate** Not determined.
- **Solubility in / Miscibility with water at 20 °C:** 8 g/l
- **Partition coefficient: n-octanol/water:** Not determined.
- **Viscosity:**
 - Dynamic at 20 °C: 0.56 mPas
 - Kinematic: Not determined.

(Contd. on page 6)

Trade name: trichloromethane

(Contd. of page 5)

- **9.2 Other information** No further relevant information available.

SECTION 10: Stability and reactivity

- **10.1 Reactivity** No dangerous reactions known.
- **10.2 Chemical stability**
- **Thermal decomposition / conditions to be avoided:**
No decomposition if used according to specifications.
- **10.3 Possibility of hazardous reactions** No dangerous reactions known.
- **10.4 Conditions to avoid** No further relevant information available.
- **10.5 Incompatible materials:**
Risk of explosion with:
Alkali metals, Alkaline earth metals, peroxi compounds, Fluorine. alcoholates, strong alkalis, Sodium hydroxide, Methanol, alkali hydroxides, Alcohols, organic nitro compounds, alkali amides, Oxygen, bases, nitrogen oxides, Amines, Ammonia, Iron, in powder form, Aluminium, magnesium, metal alloys, sensitive to stock
- **10.6 Hazardous decomposition products:** In the event of fire: See chapter 5
- **Additional information:**
heat-sensitive
light sensitive

SECTION 11: Toxicological information

- **11.1 Information on toxicological effects**
- **Acute toxicity**
Harmful if swallowed.
Toxic if inhaled.
- **LD/LC50 values relevant for classification:**

Components	Type	Value	Species
Oral	LD50	695 mg/kg (rat)	
Dermal	LD50	3,980 mg/kg (rabbit)	
- **Primary irritant effect:**
- **Skin corrosion/irritation**
Causes skin irritation.
- **Serious eye damage/irritation**
Causes serious eye irritation.
- **After inhalation:** Irritant to skin and mucous membranes.
- **Respiratory or skin sensitisation** Based on available data, the classification criteria are not met.
- **CMR effects (carcinogenity, mutagenicity and toxicity for reproduction)**
- **Germ cell mutagenicity** Based on available data, the classification criteria are not met.
- **Carcinogenicity**
Suspected of causing cancer.
- **Reproductive toxicity**
Suspected of damaging the unborn child.
- **STOT-single exposure** Based on available data, the classification criteria are not met.
- **STOT-repeated exposure**
Causes damage to organs through prolonged or repeated exposure.
- **Aspiration hazard** Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

- **12.1 Toxicity**
- **Aquatic toxicity:** Harmfull effect on aquatic organisms.

(Contd. on page 7)

Trade name: trichloromethane

(Contd. of page 6)

Type of test	Effective concentration	Method	Assessment
--------------	-------------------------	--------	------------



EC50/48 h	79 mg/l (daphnia magna)		
LC50/96 h	18 mg/l (fish)		

- **12.2 Persistence and degradability** Not easily biodegradable
- **12.3 Bioaccumulative potential**
Due to the distribution coefficient n-octanol/water a worth-mentioning accumulation in organisms is not expected.
- **12.4 Mobility in soil** No further relevant information available.
- **Additional ecological information:**
- **General notes:**
Do not allow product to reach ground water, water course or sewage system, even in small quantities.
Water hazard class 3 (German Regulation) (Assessment by list): extremely hazardous for water
Danger to drinking water if even extremely small quantities leak into the ground.
- **12.5 Results of PBT and vPvB assessment**
- **PBT:** Not applicable.
- **vPvB:** Not applicable.
- **12.6 Other adverse effects** No further relevant information available.

SECTION 13: Disposal considerations

- **13.1 Waste treatment methods**
- **Recommendation**
Chemicals must be disposed of in compliance with the respective national regulations.
Must not be disposed together with household garbage. Do not allow product to reach sewage system.
- **Uncleaned packaging:**
- **Recommendation:**
Disposal must be made according to official regulations.
Packagings that may not be cleansed are to be disposed of in the same manner as the product.

SECTION 14: Transport information

- | | |
|---|----------------------------|
| • 14.1 UN-Number | |
| • ADR, IMDG, IATA | UN1888 |
| • 14.2 UN proper shipping name | |
| • ADR, IMDG, IATA | CHLOROFORM |
| • 14.3 Transport hazard class(es) | |
| • ADR | |
|  | |
| • Class | 6.1 (T1) Toxic substances. |
| • Label | 6.1 |
| • IMDG, IATA | |
|  | |
| • Class | 6.1 Toxic substances. |
| • Label | 6.1 |

(Contd. on page 8)

GB

Trade name: trichloromethane

(Contd. of page 7)

<ul style="list-style-type: none"> 14.4 Packing group ADR, IMDG, IATA 	III
<ul style="list-style-type: none"> 14.5 Environmental hazards: Marine pollutant: 	No
<ul style="list-style-type: none"> 14.6 Special precautions for user Danger code (Kemler): EMS Number: Segregation groups Stowage Category Stowage Code 	Warning: Toxic substances. 60 F-A,S-A Liquid halogenated hydrocarbons A SW2 Clear of living quarters.
<ul style="list-style-type: none"> 14.7 Transport in bulk according to Annex II of Marpol and the IBC Code 	Not applicable.
<ul style="list-style-type: none"> Transport/Additional information: 	
<ul style="list-style-type: none"> ADR Limited quantities (LQ) Excepted quantities (EQ) 	5L Code: E1 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 1000 ml
<ul style="list-style-type: none"> Transport category Tunnel restriction code 	2 E
<ul style="list-style-type: none"> IMDG Limited quantities (LQ) Excepted quantities (EQ) 	5L Code: E1 Maximum net quantity per inner packaging: 30 ml Maximum net quantity per outer packaging: 1000 ml
<ul style="list-style-type: none"> UN "Model Regulation": 	UN 1888 CHLOROFORM, 6.1, III

SECTION 15: Regulatory information

- 15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture
- Directive 2012/18/EU
- Named dangerous substances - ANNEX I Substance is not listed.
- Seveso category H2 ACUTE TOXIC
- Qualifying quantity (tonnes) for the application of lower-tier requirements 50 t
- Qualifying quantity (tonnes) for the application of upper-tier requirements 200 t
- REGULATION (EC) No 1907/2006 ANNEX XVII Conditions of restriction: 3, 32
- Regulation (EU) No 649/2012 Annex I Part 1
- 15.2 Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

SECTION 16: Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

- Department issuing SDS: Dept. Compliance
- Abbreviations and acronyms:
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
ICAO: International Civil Aviation Organisation
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)

(Contd. on page 9)

Trade name: trichloromethane

(Contd. of page 8)

IMDG: International Maritime Code for Dangerous Goods
IATA: International Air Transport Association
GHS: Globally Harmonised System of Classification and Labelling of Chemicals
EINECS: European Inventory of Existing Commercial Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
DNEL: Derived No-Effect Level (REACH)
PNEC: Predicted No-Effect Concentration (REACH)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
PBT: Persistent, Bioaccumulative and Toxic
vPvB: very Persistent and very Bioaccumulative
Acute Tox. 4: Acute toxicity – Category 4
Acute Tox. 3: Acute toxicity – Category 3
Skin Irrit. 2: Skin corrosion/irritation – Category 2
Eye Irrit. 2: Serious eye damage/eye irritation – Category 2
Carc. 2: Carcinogenicity – Category 2
Repr. 2: Reproductive toxicity – Category 2
STOT RE 1: Specific target organ toxicity (repeated exposure) – Category 1

GB

SAFETY DATA SHEET

Version 6.4
Revision Date 01/20/2020
Print Date 08/29/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking**1.1 Product identifiers**

Product name : *cis*-1,2-Dichloroethylene

Product Number : D62004
Brand : Aldrich
Index-No. : 602-026-00-3
CAS-No. : 156-59-2

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-
527-3887 CHEMTREC (International) 24
Hours/day; 7 Days/week

SECTION 2: Hazards identification**2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 2), H225
Acute toxicity, Oral (Category 4), H302
Acute toxicity, Inhalation (Category 4), H332
Skin irritation (Category 2), H315
Short-term (acute) aquatic hazard (Category 3), H402
Long-term (chronic) aquatic hazard (Category 3), H412

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word	Danger
Hazard statement(s)	
H225	Highly flammable liquid and vapour.
H302 + H332	Harmful if swallowed or if inhaled.
H315	Causes skin irritation.
H412	Harmful to aquatic life with long lasting effects.
Precautionary statement(s)	
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 + P312	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
P403 + P235	Store in a well-ventilated place. Keep cool.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms	: cis-Acetylene dichloride
Formula	: C ₂ H ₂ Cl ₂
Molecular weight	: 96.94 g/mol
CAS-No.	: 156-59-2
EC-No.	: 205-859-7
Index-No.	: 602-026-00-3

Component	Classification	Concentration
cis-Dichloroethylene		
	Flam. Liq. 2; Acute Tox. 4; Skin Irrit. 2; Aquatic Acute 3; Aquatic Chronic 3;	<= 100 %

	H225, H302, H332, H315, H402, H412	
--	---------------------------------------	--

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Dry powder Dry sand

Unsuitable extinguishing media

Do NOT use water jet.

5.2 Special hazards arising from the substance or mixture

Carbon oxides, Hydrogen chloride gas

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

Use water spray to cool unopened containers.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13).

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Handle and store under inert gas. Air and moisture sensitive. Light sensitive.

Storage class (TRGS 510): 3: Flammable liquids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
cis-Dichloroethylene	156-59-2	TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Central Nervous System impairment Eye irritation		

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a) Appearance	Form: liquid Colour: light yellow
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: -80 °C (-112 °F) - lit.
f) Initial boiling point and boiling range	60 °C 140 °F - lit.
g) Flash point	6.0 °C (42.8 °F) - closed cup
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower	No data available

flammability or
explosive limits

- | | |
|--|--|
| k) Vapour pressure | No data available |
| l) Vapour density | No data available |
| m) Relative density | 1.284 g/cm ³ at 25 °C (77 °F) |
| n) Water solubility | No data available |
| o) Partition coefficient:
n-octanol/water | No data available |
| p) Auto-ignition
temperature | No data available |
| q) Decomposition
temperature | No data available |
| r) Viscosity | No data available |
| s) Explosive properties | No data available |
| t) Oxidizing properties | No data available |

9.2 Other safety information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

10.4 Conditions to avoid

Heat, flames and sparks.

10.5 Incompatible materials

Oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides, Hydrogen chloride gas

Other decomposition products - No data available

In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - 770 mg/kg

LC50 Inhalation - Rat - 13700 ppm

Remarks: Behavioral: Somnolence (general depressed activity). Liver: Fatty liver degeneration.

Dermal: No data available

No data available

Skin corrosion/irritation

Skin - Rabbit

Result: Moderate skin irritation - 24 h

Serious eye damage/eye irritation

No data available

Respiratory or skin sensitisation

No data available

Germ cell mutagenicity

No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

Additional Information

RTECS: KV9420000

narcosis, To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

No data available

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Harmful to aquatic life with long lasting effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Contact a licensed professional waste disposal service to dispose of this material.

Contaminated packaging

Dispose of as unused product.

SECTION 14: Transport information

DOT (US)

UN number: 1150 Class: 3 Packing group: II

Proper shipping name: 1,2-Dichloroethylene

Reportable Quantity (RQ):

Poison Inhalation Hazard: No

IMDG

UN number: 1150 Class: 3 Packing group: II

EMS-No: F-E, S-D

Proper shipping name: 1,2-DICHLOROETHYLENE

IATA

UN number: 1150 Class: 3 Packing group: II

Proper shipping name: 1,2-Dichloroethylene

SECTION 15: Regulatory information

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards

Fire Hazard

Massachusetts Right To Know Components

No components are subject to the Massachusetts Right to Know Act.

Pennsylvania Right To Know Components

cis-Dichloroethylene	CAS-No. 156-59-2	Revision Date 1993-04-24
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cis-Dichloroethylene	CAS-No. 156-59-2	Revision Date 1993-04-24
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New Jersey Right To Know Components

cis-Dichloroethylene	CAS-No. 156-59-2	Revision Date 1993-04-24
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California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

SECTION 16: Other information

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

Version: 6.4

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Print Date: 08/29/2020

SAFETY DATA SHEET

According to OSHA Hazard Communication Standard, 29 CFR 1910.1200

Ethyl benzene

Version	Revision Date:	SDS Number:	Print Date: 06/13/2018
6.0	06/07/2018	800001001033	Date of last issue: 12/08/2015

SECTION 1. IDENTIFICATION

Product name : Ethyl benzene

Product code : Q9212

Synonyms : EB, phenyl ethane

CAS-No. : 100-41-4

Manufacturer or supplier's details

Company : **Shell Chemical LP**
PO Box 576
HOUSTON TX 77001
USA

SDS Request : 1-800-240-6737

Customer Service : 1-855-697-4355

Emergency telephone number

Chemtrec Domestic (24 hr) : 1-800-424-9300

Chemtrec International (24 hr) : 1-703-527-3887

Recommended use of the chemical and restrictions on use

Recommended use : Intermediate in styrene monomer manufacture.

Restrictions on use : This product must not be used in applications other than the above without first seeking the advice of the supplier.

SECTION 2. HAZARDS IDENTIFICATION

GHS classification in accordance with 29 CFR 1910.1200

Flammable liquids : Category 2

Aspiration hazard : Category 1

Skin irritation : Category 2

Eye irritation : Category 2A

Acute toxicity (Inhalation) : Category 4

Specific target organ toxicity : Category 3
- single exposure

Specific target organ toxicity : Category 2 (Auditory system)
- repeated exposure

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Chronic aquatic toxicity : Category 3

GHS label elements

Hazard pictograms :



Signal word : Danger

Hazard statements : PHYSICAL HAZARDS:
H225 Highly flammable liquid and vapour.
HEALTH HAZARDS:
H304 May be fatal if swallowed and enters airways.
H315 Causes skin irritation.
H319 Causes serious eye irritation.
H332 Harmful if inhaled.
H335 May cause respiratory irritation.
H373 May cause damage to organs (Auditory system) through prolonged or repeated exposure.
ENVIRONMENTAL HAZARDS:
H412 Harmful to aquatic life with long lasting effects.

Precautionary statements : **Prevention:**
P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P240 Ground/bond container and receiving equipment.
P241 Use explosion-proof electrical/ ventilating/ lighting equipment.
P242 Use only non-sparking tools.
P243 Take precautionary measures against static discharge.
P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264 Wash hands thoroughly after handling.
P271 Use only outdoors or in a well-ventilated area.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P273 Avoid release to the environment.
Response:
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P370 + P378 In case of fire: Use appropriate media to extinguish.
P301 + P310 IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P331 Do NOT induce vomiting.
P302 + P352 IF ON SKIN: Wash with plenty of water and soap.
P332 + P313 If skin irritation occurs: Get medical advice/ attention.
P362 + P364 Take off contaminated clothing and wash it before reuse.

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P304 + P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P312 Call a POISON CENTER/doctor if you feel unwell.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P337 + P313 If eye irritation persists: Get medical advice/ attention.

Storage:

P403 + P233 Store in a well-ventilated place. Keep container tightly closed.
P235 Keep cool.
P405 Store locked up.

Disposal:

P501 Dispose of contents and container to appropriate waste site or reclaimer in accordance with local and national regulations.

Other hazards which do not result in classification

Vapours are heavier than air. Vapours may travel across the ground and reach remote ignition sources causing a flashback fire danger.
This material is a static accumulator.
Even with proper grounding and bonding, this material can still accumulate an electrostatic charge.
If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur.
The classification of this material is based on OSHA HCS 2012 criteria.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance / Mixture : Substance
Chemical nature : Contains Ethylbenzene, CAS # 100-41-4.

Hazardous components

Chemical name	Synonyms	CAS-No.	Concentration (% w/w)
Ethylbenzene	ethylbenzene	100-41-4	>= 99.8

SECTION 4. FIRST-AID MEASURES

General advice : Take appropriate steps to avoid fire, explosion and inhalation hazards.
If inhaled : Call emergency number for your location / facility.
Remove to fresh air. Do not attempt to rescue the victim unless proper respiratory protection is worn. If the victim has difficulty breathing or tightness of the chest, is dizzy, vomiting, or unresponsive, give 100% oxygen with rescue breathing or Cardio-Pulmonary Resuscitation as required and transport to

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Ethyl benzene

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-
- the nearest medical facility.
- In case of skin contact : Remove contaminated clothing. Immediately flush skin with large amounts of water for at least 15 minutes, and follow by washing with soap and water if available. If redness, swelling, pain and/or blisters occur, transport to the nearest medical facility for additional treatment.
- In case of eye contact : Immediately flush eye(s) with plenty of water. Remove contact lenses, if present and easy to do. Continue rinsing. Transport to the nearest medical facility for additional treatment.
- If swallowed : Call emergency number for your location / facility. If swallowed, do not induce vomiting: transport to nearest medical facility for additional treatment. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. If any of the following delayed signs and symptoms appear within the next 6 hours, transport to the nearest medical facility: fever greater than 101° F (38.3°C), shortness of breath, chest congestion or continued coughing or wheezing.
- Most important symptoms and effects, both acute and delayed : The onset of respiratory symptoms may be delayed for several hours after exposure. Kidney damage may be indicated by changes in urine output or appearance, pain upon urination or in the lower back, or general oedema (swelling from fluid retention).

Liver damage may be indicated by loss of appetite, jaundice (yellowish skin and eye colour), fatigue, bleeding or easy bruising and sometimes pain and swelling in the upper right abdomen.
- Protection of first-aiders : When administering first aid, ensure that you are wearing the appropriate personal protective equipment according to the incident, injury and surroundings.
- Indication of any immediate medical attention and special treatment needed : Call a doctor or poison control center for guidance.

SECTION 5. FIRE-FIGHTING MEASURES

- Suitable extinguishing media : Foam, water spray or fog. Dry chemical powder, carbon dioxide, sand or earth may be used for small fires only.
- Unsuitable extinguishing media : Do not use water in a jet.
- Specific hazards during fire- : Clear fire area of all non-emergency personnel.

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-
- | | | |
|---|---|--|
| fighting | | Hazardous combustion products may include:
A complex mixture of airborne solid and liquid particulates and gases (smoke).
Carbon monoxide.
Unidentified organic and inorganic compounds.
Flammable vapours may be present even at temperatures below the flash point.
The vapour is heavier than air, spreads along the ground and distant ignition is possible.
Will float and can be reignited on surface water. |
| Specific extinguishing methods | : | Standard procedure for chemical fires. |
| Further information | : | Keep adjacent containers cool by spraying with water. |
| Special protective equipment for firefighters | : | Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469). |

SECTION 6. ACCIDENTAL RELEASE MEASURES

- | | | |
|---|---|--|
| Personal precautions, protective equipment and emergency procedures | : | Observe all relevant local and international regulations.
Notify authorities if any exposure to the general public or the environment occurs or is likely to occur.
Local authorities should be advised if significant spillages cannot be contained.
Avoid contact with skin, eyes and clothing.
Isolate hazard area and deny entry to unnecessary or unprotected personnel.
Do not breathe fumes, vapour.
Do not operate electrical equipment. |
| Environmental precautions | : | Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area. Use appropriate containment to avoid environmental contamination. Prevent from spreading or entering drains, ditches or rivers by using sand, earth, or other appropriate barriers. Attempt to disperse the vapour or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Monitor area with combustible gas indicator. |
| Methods and materials for containment and cleaning up | : | For small liquid spills (< 1 drum), transfer by mechanical means to a labeled, sealable container for product recovery or safe disposal. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely.
For large liquid spills (> 1 drum), transfer by mechanical |

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1910.1200

Ethyl benzene

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means such as vacuum truck to a salvage tank for recovery or safe disposal. Do not flush away residues with water. Retain as contaminated waste. Allow residues to evaporate or soak up with an appropriate absorbent material and dispose of safely. Remove contaminated soil and dispose of safely

Ventilate contaminated area thoroughly.
If contamination of site occurs remediation may require specialist advice.

Additional advice

: For guidance on selection of personal protective equipment see Chapter 8 of this Safety Data Sheet.
For guidance on disposal of spilled material see Chapter 13 of this Safety Data Sheet.

U.S. regulations may require reporting releases of this material to the environment which exceed the reportable quantity (refer to Chapter 15) to the National Response Center at (800) 424-8802.

Under Section 311 of the Clean Water Act (CWA) this material is considered an oil. As such, spills into surface waters must be reported to the National Response Center at (800) 424-8802.

This material is covered by EPA's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Petroleum Exclusion. Therefore, releases to the environment may not be reportable under CERCLA.

SECTION 7. HANDLING AND STORAGE

Technical measures

: Avoid breathing of or direct contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Safety Data Sheet.
Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material.
Ensure that all local regulations regarding handling and storage facilities are followed.

Advice on safe handling

: Avoid inhaling vapour and/or mists.
Avoid contact with skin, eyes and clothing.
Extinguish any naked flames. Do not smoke. Remove ignition sources. Avoid sparks.
Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols.
Bulk storage tanks should be diked (bunded).
When using do not eat or drink.

The vapour is heavier than air, spreads along the ground and

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distant ignition is possible.

Avoidance of contact : Strong oxidising agents.

Product Transfer : Even with proper grounding and bonding, this material can still accumulate an electrostatic charge. If sufficient charge is allowed to accumulate, electrostatic discharge and ignition of flammable air-vapour mixtures can occur. Be aware of handling operations that may give rise to additional hazards that result from the accumulation of static charges. These include but are not limited to pumping (especially turbulent flow), mixing, filtering, splash filling, cleaning and filling of tanks and containers, sampling, switch loading, gauging, vacuum truck operations, and mechanical movements. These activities may lead to static discharge e.g. spark formation. Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (≤ 1 m/s until fill pipe submerged to twice its diameter, then ≤ 7 m/s). Avoid splash filling. Do NOT use compressed air for filling, discharging, or handling operations.

Refer to guidance under Handling section.

Conditions for safe storage : Refer to section 15 for any additional specific legislation covering the packaging and storage of this product.

Further information on storage stability : Storage Temperature:
Ambient.

Bulk storage tanks should be diked (bunded).
Locate tanks away from heat and other sources of ignition.
Cleaning, inspection and maintenance of storage tanks is a specialist operation, which requires the implementation of strict procedures and precautions.
Must be stored in a diked (bunded) well-ventilated area, away from sunlight, ignition sources and other sources of heat.
Keep away from aerosols, flammables, oxidizing agents, corrosives and from other flammable products which are not harmful or toxic to man or to the environment.
Electrostatic charges will be generated during pumping.
Electrostatic discharge may cause fire. Ensure electrical continuity by bonding and grounding (earthing) all equipment to reduce the risk.
The vapours in the head space of the storage vessel may lie in the flammable/explosive range and hence may be flammable.

Packaging material : Suitable material: For containers, or container linings use mild steel, stainless steel., For container paints, use epoxy paint, zinc silicate paint.
Unsuitable material: Avoid prolonged contact with natural, butyl or nitrile rubbers.

Container Advice : Do not cut, drill, grind, weld or perform similar operations on or

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near containers.

Specific use(s) : Not applicable

See additional references that provide safe handling practices for liquids that are determined to be static accumulators: American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practices on Static Electricity).
IEC/TS 60079-32-1: Electrostatic hazards, guidance

SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
Ethylbenzene	100-41-4	TWA	20 ppm	ACGIH
Ethylbenzene		TWA	100 ppm 435 mg/m3	OSHA Z-1

Biological occupational exposure limits

Components	CAS-No.	Control parameters	Biological specimen	Sampling time	Permissible concentration	Basis
Ethylbenzene	100-41-4	Sum of mandelic acid and phenyl glyoxylic acid	Urine	End of shift (As soon as possible after exposure ceases)	0.15 g/g creatinine	ACGIH BEI
				End of shift	0,15 g/g creatinine	ACGIH BEI

Monitoring Methods

Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate.

Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory.

Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available.

National Institute of Occupational Safety and Health (NIOSH), USA: Manual of Analytical Methods <http://www.cdc.gov/niosh/>

Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods <http://www.osha.gov/>

Health and Safety Executive (HSE), UK: Methods for the Determination of Hazardous Substances

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es <http://www.hse.gov.uk/>
Institut für Arbeitsschutz Deutschen Gesetzlichen Unfallversicherung (IFA) , Germany
<http://www.dguv.de/inhalt/index.jsp>
L'Institut National de Recherche et de Sécurité, (INRS), France <http://www.inrs.fr/accueil>

Engineering measures : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include:
Use sealed systems as far as possible.
Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits.
Local exhaust ventilation is recommended.
Firewater monitors and deluge systems are recommended.
Where material is heated, sprayed or mist formed, there is greater potential for airborne concentrations to be generated.
Eye washes and showers for emergency use.

General Information:

Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned.
Practice good housekeeping.
Define procedures for safe handling and maintenance of controls.
Educate and train workers in the hazards and control measures relevant to normal activities associated with this product.
Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation.
Drain down system prior to equipment break-in or maintenance.
Retain drain downs in sealed storage pending disposal or subsequent recycle.

Personal protective equipment

Respiratory protection : If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. If air-filtering respirators are suitable for conditions of use: Select a filter suitable for organic gases and vapours [Type A

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boiling point >65°C (149°F)].

Respirator selection, use and maintenance should be in accordance with the requirements of the OSHA Respiratory Protection Standard, 29 CFR 1910.134.

Hand protection Remarks

: Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection. Longer term protection: Viton. Incidental contact/Splash protection: Nitrile rubber. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced.
For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same, but recognize that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time maybe acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material. Glove thickness should be typically greater than 0.35 mm depending on the glove make and model.
Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended.

Eye protection

: Wear goggles for use against liquids and gas.
Wear full face shield if splashes are likely to occur.

Skin and body protection

: Wear chemical resistant gloves/gauntlets and boots. Where risk of splashing, also wear an apron.
Wear antistatic and flame retardant clothing.

Protective measures

: Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.

Hygiene measures

: Wash hands before eating, drinking, smoking and using the toilet.
Launder contaminated clothing before re-use.
Do not ingest. If swallowed then seek immediate medical assistance.

Environmental exposure controls

General advice

: Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.

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Information on accidental release measures are to be found in
section 6.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	: Clear, mobile liquid.
Colour	: Data not available
Odour	: Aromatic hydrocarbon
Odour Threshold	: Data not available
pH	: Not applicable
Melting / freezing point	: -95 °C / -139 °F
Boiling point/boiling range	: 136.2 °C / 277.2 °F
Flash point	: 22 - 23 °C / 72 - 73 °F
Evaporation rate	: Data not available
Flammability (solid, gas)	: Not applicable
Upper explosion limit / upper flammability limit	: 8 %(V)
Lower explosion limit / Lower flammability limit	: 1.2 %(V)
Vapour pressure	: 500 Pa (10 °C / 50 °F)
	950 Pa (20 °C / 68 °F)
	7,400 Pa (60 °C / 140 °F)
	47,000 Pa (110 °C / 230 °F)
Relative vapour density	: 3.7
Relative density	: 0.86
Density	: 868 kg/m ³ (20 °C / 68 °F)
Solubility(ies)	
Water solubility	: 0.2 g/l
Solubility in other solvents	: Readily soluble in various organic solvents.

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Partition coefficient: n-octanol/water : log Pow: 3.6

Auto-ignition temperature : 430 °C / 806 °F

Decomposition temperature : Data not available

Viscosity
Viscosity, dynamic : 0.671 mPa.s (20 °C / 68 °F)

Viscosity, kinematic : 0.5 mm²/s (60 °C / 140 °F)

0.9 mm²/s (10 °C / 50 °F)

0.32 mm²/s (110 °C / 230 °F)

0.773 mm²/s (25 °C / 77 °F)

Explosive properties : Not applicable

Oxidizing properties : Data not available

Surface tension : 71.2 mN/m

Conductivity : Low conductivity: < 100 pS/m

The conductivity of this material makes it a static accumulator., A liquid is typically considered nonconductive if its conductivity is below 100 pS/m and is considered semi-conductive if its conductivity is below 10,000 pS/m., Whether a liquid is nonconductive or semi-conductive, the precautions are the same., A number of factors, for example liquid temperature, presence of contaminants, and anti-static additives can greatly influence the conductivity of a liquid

Molecular weight : 106.16 g/mol

SECTION 10. STABILITY AND REACTIVITY

Reactivity : The product does not pose any further reactivity hazards in addition to those listed in the following sub-paragraph.

Chemical stability : No hazardous reaction is expected when handled and stored according to provisions
Stable under normal conditions of use.

Possibility of hazardous reac- : Reacts with strong oxidising agents.

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tions

- | | | |
|----------------------------------|---|--|
| Conditions to avoid | : | Avoid heat, sparks, open flames and other ignition sources.

In certain circumstances product can ignite due to static electricity. |
| Incompatible materials | : | Strong oxidising agents. |
| Hazardous decomposition products | : | Hazardous decomposition products are not expected to form during normal storage.
Thermal decomposition is highly dependent on conditions. A complex mixture of airborne solids, liquids and gases including carbon monoxide, carbon dioxide, sulphur oxides and unidentified organic compounds will be evolved when this material undergoes combustion or thermal or oxidative degradation. |

SECTION 11. TOXICOLOGICAL INFORMATION

Basis for assessment : Information given is based on product testing.

Information on likely routes of exposure

Exposure may occur via inhalation, ingestion, skin absorption, skin or eye contact, and accidental ingestion.

Acute toxicity

Product:

- | | | |
|---------------------------|---|--|
| Acute oral toxicity | : | LD50 (Rat): > 2000 - 5000 mg/kg
Remarks: May be harmful if swallowed. |
| Acute inhalation toxicity | : | LC50 : > 10 - 20 mg/l
Remarks: Harmful if inhaled. |
| Acute dermal toxicity | : | LD50 (Rabbit): > 5000 mg/kg
Remarks: Low toxicity: |

Skin corrosion/irritation

Product:

Remarks: Causes skin irritation.

Serious eye damage/eye irritation

Product:

Remarks: Causes serious eye irritation.

Respiratory or skin sensitisation

Product:

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Remarks: Not a sensitiser.
Based on available data, the classification criteria are not met.

Germ cell mutagenicity

Product:

: Remarks: Not mutagenic.

Carcinogenicity

Product:

Remarks: Limited evidence of carcinogenic effect, Causes cancer in laboratory animals.

IARC

Group 2B: Possibly carcinogenic to humans

Ethylbenzene

100-41-4

OSHA

No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

NTP

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

Reproductive toxicity

Product:

:
Remarks: Not a developmental toxicant., Based on available data, the classification criteria are not met., Does not impair fertility.

STOT - single exposure

Product:

Remarks: Inhalation of vapours or mists may cause irritation to the respiratory system.

STOT - repeated exposure

Product:

Remarks: Harmful: danger of serious damage to health by prolonged exposure through inhalation., Auditory system: prolonged and repeated exposures to high concentrations have resulted in hearing loss in rats. Solvent abuse and noise interaction in the work environment may cause hearing loss., Kidney: can cause kidney damage., Liver: can cause liver damage., Central nervous system: repeated exposure affects the nervous system.

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Aspiration toxicity

Product:

Aspiration into the lungs when swallowed or vomited may cause chemical pneumonitis which can be fatal.

Further information

Product:

Remarks: Classifications by other authorities under varying regulatory frameworks may exist.

SECTION 12. ECOLOGICAL INFORMATION

Basis for assessment : Information given is based on product testing.

Ecotoxicity

Product:

Toxicity to fish (Acute toxicity) :
Remarks: Toxic
LC/EC/IC50 >1 - <=10 mg/l

Toxicity to daphnia and other aquatic invertebrates (Acute toxicity) :
Remarks: Toxic
LC/EC/IC50 >1 - <=10 mg/l

Toxicity to algae (Acute toxicity) :
EC50:
Remarks: Toxic
LC/EC/IC50 >1 - <=10 mg/l

Toxicity to fish (Chronic toxicity) :
Remarks: NOEC/NOEL > 0.1 - <=1.0 mg/l

Toxicity to microorganisms (Acute toxicity) :
Remarks: Harmful
LC/EC/IC50 >10 - <=100 mg/l

Persistence and degradability

Product:

Biodegradability :
Remarks: Readily biodegradable.
Oxidises rapidly by photo-chemical reactions in air.

Bioaccumulative potential

Product:

Bioaccumulation :
Remarks: Does not bioaccumulate significantly.

Mobility in soil

Product:

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Mobility : Remarks: If the product enters soil, one or more constituents will or may be mobile and may contaminate groundwater. Floats on water.

Other adverse effects

Product:

Additional ecological information : In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life.

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods

Waste from residues : Recover or recycle if possible.
It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations.

Do not dispose into the environment, in drains or in water courses

Waste product should not be allowed to contaminate soil or ground water, or be disposed of into the environment.
Waste, spills or used product is dangerous waste.

Disposal should be in accordance with applicable regional, national, and local laws and regulations.
Local regulations may be more stringent than regional or national requirements and must be complied with.

Contaminated packaging : Drain container thoroughly.
After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard. Do not puncture, cut or weld uncleaned drums.
Send to drum recoverer or metal reclaimer.
Comply with any local recovery or waste disposal regulations.

SECTION 14. TRANSPORT INFORMATION

National Regulations

US Department of Transportation Classification (49 CFR Parts 171-180)

UN/ID/NA number	: UN 1175
Proper shipping name	: ETHYLBENZENE
Class	: 3
Packing group	: II
Labels	: 3
Reportable quantity	ETHYLBENZENE (1,000 lb)

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ERG Code : 130
Marine pollutant : no

International Regulations

IATA-DGR

UN/ID No. : UN 1175
Proper shipping name : ETHYLBENZENE
Class : 3
Packing group : II
Labels : 3

IMDG-Code

UN number : UN 1175
Proper shipping name : ETHYLBENZENE
Class : 3
Packing group : II
Labels : 3
Marine pollutant : no

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution category : Y
Ship type : 2
Product name : Ethyl benzene

Special precautions for user

Remarks : Special Precautions: Refer to Chapter 7, Handling & Storage, for special precautions which a user needs to be aware of or needs to comply with in connection with transport.

Additional Information : This product may be transported under nitrogen blanketing. Nitrogen is an odourless and invisible gas. Exposure to nitrogen enriched atmospheres displaces available oxygen which may cause asphyxiation or death. Personnel must observe strict safety precautions when involved with a confined space entry.

SECTION 15. REGULATORY INFORMATION

EPCRA - Emergency Planning and Community Right-to-Know Act

CERCLA Reportable Quantity

Components	CAS-No.	Component RQ (lbs)	Calculated product RQ (lbs)
Ethylbenzene	100-41-4	1000	1000
Ethylbenzene	100-41-4	100	100 (F003)

*: The components with RQs are given for information., Shell classifies this material as an "oil" under the CERCLA Petroleum Exclusion, therefore releases to the environment are not reportable under CERCLA.

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SARA 304 Extremely Hazardous Substances Reportable Quantity

This material does not contain any components with a section 304 EHS RQ.

SARA 302 Extremely Hazardous Substances Threshold Planning Quantity

This material does not contain any components with a section 302 EHS TPQ.

SARA 311/312 Hazards : Flammable (gases, aerosols, liquids, or solids)
Acute toxicity (any route of exposure)
Skin corrosion or irritation
Serious eye damage or eye irritation
Specific target organ toxicity (single or repeated exposure)
Aspiration hazard

SARA 313 : The following components are subject to reporting levels established by SARA Title III, Section 313:

Ethylbenzene	100-41-4	>= 90 - <= 100 %
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Clean Water Act

The following Hazardous Chemicals are listed under the U.S. CleanWater Act, Section 311, Table 117.3:

Ethylbenzene	100-41-4	100 %
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US State Regulations

Pennsylvania Right To Know

Ethylbenzene	100-41-4
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California Prop. 65

WARNING: This product can expose you to chemicals including Ethylbenzene, which is/are known to the State of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

California List of Hazardous Substances

Ethylbenzene	100-41-4
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Other regulations:

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

The components of this product are reported in the following inventories:

AIIC	: Listed
DSL	: Listed
IECSC	: Listed
ENCS	: Listed
ENCS	: Listed
KECI	: Listed

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NZIoC	: Listed
PICCS	: Listed
TSCA	: Listed
EINECS	: Listed
TCSI	: Listed

SECTION 16. OTHER INFORMATION

Further information

NFPA Rating (Health, Fire, Reactivity) 2, 3, 0

Full text of other abbreviations

ACGIH	: USA. ACGIH Threshold Limit Values (TLV)
ACGIH BEI	: ACGIH - Biological Exposure Indices (BEI)
OSHA Z-1	: USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
ACGIH / TWA	: 8-hour, time-weighted average
OSHA Z-1 / TWA	: 8-hour time weighted average
Abbreviations and Acronyms	: The standard abbreviations and acronyms used in this document can be looked up in reference literature (e.g. scientific dictionaries) and/or websites.

ACGIH = American Conference of Governmental Industrial Hygienists
ADR = European Agreement concerning the International Carriage of Dangerous Goods by Road
AICS = Australian Inventory of Chemical Substances
ASTM = American Society for Testing and Materials
BEL = Biological exposure limits
BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
CAS = Chemical Abstracts Service
CEFIC = European Chemical Industry Council
CLP = Classification Packaging and Labelling
COC = Cleveland Open-Cup
DIN = Deutsches Institut für Normung
DMEL = Derived Minimal Effect Level
DNEL = Derived No Effect Level
DSL = Canada Domestic Substance List
EC = European Commission
EC50 = Effective Concentration fifty
ECETOC = European Center on Ecotoxicology and Toxicology Of Chemicals
ECHA = European Chemicals Agency
EINECS = The European Inventory of Existing Commercial

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Chemical Substances
EL50 = Effective Loading fifty
ENCS = Japanese Existing and New Chemical Substances Inventory
EWC = European Waste Code
GHS = Globally Harmonised System of Classification and Labelling of Chemicals
IARC = International Agency for Research on Cancer
IATA = International Air Transport Association
IC50 = Inhibitory Concentration fifty
IL50 = Inhibitory Level fifty
IMDG = International Maritime Dangerous Goods
INV = Chinese Chemicals Inventory
IP346 = Institute of Petroleum test method N° 346 for the determination of polycyclic aromatics DMSO-extractables
KECI = Korea Existing Chemicals Inventory
LC50 = Lethal Concentration fifty
LD50 = Lethal Dose fifty per cent.
LL/EL/IL = Lethal Loading/Effective Loading/Inhibitory loading
LL50 = Lethal Loading fifty
MARPOL = International Convention for the Prevention of Pollution From Ships
NOEC/NOEL = No Observed Effect Concentration / No Observed Effect Level
OE_HP V = Occupational Exposure - High Production Volume
PBT = Persistent, Bioaccumulative and Toxic
PICCS = Philippine Inventory of Chemicals and Chemical Substances
PNEC = Predicted No Effect Concentration
REACH = Registration Evaluation And Authorisation Of Chemicals
RID = Regulations Relating to International Carriage of Dangerous Goods by Rail
SKIN_DES = Skin Designation
STEL = Short term exposure limit
TRA = Targeted Risk Assessment
TSCA = US Toxic Substances Control Act
TWA = Time-Weighted Average
vPvB = very Persistent and very Bioaccumulative

A vertical bar (|) in the left margin indicates an amendment from the previous version.
This product is classified as H304 (May be fatal if swallowed and enters airways). The risk relates to potential for aspiration. The risk arising from aspiration hazard is solely related to the physico-chemical properties of the substance. The risk can therefore be controlled by implementing risk management measures tailored to this specific hazard and included within Chapter 8 of the SDS. An exposure scenario is not presented.

Due to a change in detail in Section 15, this document has been released as a significant change.

Sources of key data used to compile the Safety Data Sheet : The quoted data are from, but not limited to, one or more sources of information (e.g. toxicological data from Shell Health Services, material suppliers' data, CONCAWE, EU IUCLID data base, EC 1272 regulation, etc).

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The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

US / EN

Helium, compressed

Safety Data Sheet P-4602

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1979 Revision date: 10/17/2016 Supersedes: 06/23/2015

SECTION: 1. Product and company identification

1.1. Product identifier

Product form : Substance
Name : Helium, compressed
CAS No : 7440-59-7
Formula : He
Other means of identification : Helium-4, refrigerant gas R-704, LaserStar Helium, Medipure Helium, UltraLift Helium, Helium - Diving Grade

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture : Industrial use
Medical applications
Diving Gas (Underwater Breathing)

1.3. Details of the supplier of the safety data sheet

Praxair, Inc.
10 Riverview Drive
Danbury, CT 06810-6268 - USA
T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879-2146
www.praxair.com

1.4. Emergency telephone number

Emergency number : Onsite Emergency: 1-800-645-4633

CHEMTREC, 24hr/day 7days/week
— Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887
(collect calls accepted, Contract 17729)

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS-US classification

Compressed gas H280

2.2. Label elements

GHS-US labeling

Hazard pictograms (GHS-US) :



GHS04

Signal word (GHS-US) : WARNING
Hazard statements (GHS-US) : H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION
Precautionary statements (GHS-US) : P202 - Do not handle until all safety precautions have been read and understood
P271 - Use and store only outdoors or in a well-ventilated area
P403 - Use and store only outdoors or in a well-ventilated place
CGA-PG05 - Use a back flow preventive device in the piping
CGA-PG10 - Use only with equipment rated for cylinder pressure
CGA-PG06 - Close valve after each use and when empty
CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F)

2.3. Other hazards

Other hazards not contributing to the : Asphyxiant in high concentrations.

classification

2.4. Unknown acute toxicity (GHS US)

No data available

SECTION 3: Composition/Information on ingredients

3.1. Substance

Name : Helium, compressed
CAS No : 7440-59-7

Name	Product identifier	%
Helium	(CAS No) 7440-59-7	99.5 - 100

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remove to fresh air and keep at rest in a position comfortable for breathing. If not breathing, give artificial respiration. If breathing is difficult, trained personnel should give oxygen. Call a physician.

First-aid measures after skin contact : Adverse effects not expected from this product.

First-aid measures after eye contact : Adverse effects not expected from this product. In case of eye irritation: Rinse immediately with plenty of water. Consult an ophthalmologist if irritation persists.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Use extinguishing media appropriate for surrounding fire.

5.2. Special hazards arising from the substance or mixture

No additional information available

5.3. Advice for firefighters

Firefighting instructions : Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Protection during firefighting : Compressed gas: asphyxiant. Suffocation hazard by lack of oxygen.

Special protective equipment for fire fighters : Use self-contained breathing apparatus. Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.

Specific methods : Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas containers to rupture. Cool endangered containers with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems

Stop flow of product if safe to do so

Use water spray or fog to knock down fire fumes if possible.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures : Evacuate area. Ensure adequate air ventilation. Wear self-contained breathing apparatus when entering area unless atmosphere is proven to be safe. Stop leak if safe to do so.

Helium, compressed

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6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Try to stop release.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.

SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling

: Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g. wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

Safe use of the product

: **The suitability of this product as a component in underwater breathing gas mixtures** is to be determined by or under the supervision of personnel experienced in the use of underwater breathing gas mixtures and familiar with the physiological effects, methods employed, frequency and duration of use, hazards, side effects, and precautions to be taken.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions

: Store in a cool, well-ventilated place. Store and use with adequate ventilation. Store only where temperature will not exceed 125°F (52°C). Firmly secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Helium, compressed (7440-59-7)	
ACGIH	Not established
USA OSHA	Not established
Helium (7440-59-7)	
ACGIH	Not established
USA OSHA	Not established

Helium, compressed

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8.2. Exposure controls

Appropriate engineering controls	: Use a local exhaust system with sufficient flow velocity to maintain an adequate supply of air in the worker's breathing zone. Mechanical (general): General exhaust ventilation may be acceptable if it can maintain an adequate supply of air.
Eye protection	: Wear safety glasses with side shields.
Skin and body protection	: Wear metatarsal shoes and work gloves for cylinder handling, and protective clothing where needed. Wear appropriate chemical gloves during cylinder changeout or wherever contact with product is possible. Select per OSHA 29 CFR 1910.132, 1910.136, and 1910.138.
Respiratory protection	: When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Gas
Appearance	: Colorless gas.
Molecular mass	: 4 g/mol
Color	: Colorless.
Odor	: Odorless.
Odor threshold	: No data available
pH	: Not applicable.
Relative evaporation rate (butyl acetate=1)	: No data available
Relative evaporation rate (ether=1)	: Not applicable.
Melting point	: -272 °C
Freezing point	: No data available
Boiling point	: -268.93 °C
Flash point	: No data available
Critical temperature	: -268 °C
Auto-ignition temperature	: Not applicable.
Decomposition temperature	: No data available
Flammability (solid, gas)	: No data available
Vapor pressure	: Not applicable.
Critical pressure	: 230 kPa
Relative vapor density at 20 °C	: No data available
Relative density	: No data available
Density	: 0.166 kg/m ³
Relative gas density	: 0.14
Solubility	: Water: 1.5 mg/l
Log Pow	: Not applicable.
Log Kow	: Not applicable.
Viscosity, kinematic	: Not applicable.
Viscosity, dynamic	: Not applicable.
Explosive properties	: Not applicable.
Oxidizing properties	: None.
Explosion limits	: No data available

9.2. Other information

Gas group	: Compressed gas
Additional information	: None

Helium, compressed

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SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

None.

10.4. Conditions to avoid

None under recommended storage and handling conditions (see section 7).

10.5. Incompatible materials

None.

10.6. Hazardous decomposition products

None.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity : Not classified

Skin corrosion/irritation : Not classified
pH: Not applicable.

Serious eye damage/irritation : Not classified
pH: Not applicable.

Respiratory or skin sensitization : Not classified

Germ cell mutagenicity : Not classified

Carcinogenicity : Not classified

Reproductive toxicity : Not classified

Specific target organ toxicity (single exposure) : Not classified

Specific target organ toxicity (repeated exposure) : Not classified

Aspiration hazard : Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No ecological damage caused by this product.

12.2. Persistence and degradability

Helium, compressed (7440-59-7)

Persistence and degradability	No ecological damage caused by this product.
-------------------------------	--

Helium (7440-59-7)

Persistence and degradability	No ecological damage caused by this product.
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12.3. Bioaccumulative potential

Helium, compressed (7440-59-7)

Log Pow	Not applicable.
Log Kow	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

Helium (7440-59-7)

Log Pow	Not applicable for inorganic gases.
Log Kow	Not applicable.

Helium, compressed

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Helium (7440-59-7)

Bioaccumulative potential	No ecological damage caused by this product.
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12.4. Mobility in soil

Helium, compressed (7440-59-7)

Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

Helium (7440-59-7)

Mobility in soil	No data available.
Ecology - soil	No ecological damage caused by this product.

12.5. Other adverse effects

Effect on ozone layer : None

Effect on the global warming : None

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste disposal recommendations : Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

SECTION 14: Transport information

In accordance with DOT

Transport document description	: UN1046 Helium, compressed, 2.2
UN-No.(DOT)	: UN1046
Proper Shipping Name (DOT)	: Helium, compressed
Class (DOT)	: 2.2 - Class 2.2 - Non-flammable compressed gas 49 CFR 173.115
Hazard labels (DOT)	: 2.2 - Non-flammable gas



Additional information

Emergency Response Guide (ERG) Number	: 120 (UN1963);121 (UN1046)
Other information	: No supplementary information available.
Special transport precautions	: Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.

Transport by sea

UN-No. (IMDG)	: 1046
Proper Shipping Name (IMDG)	: HELIUM, COMPRESSED
Class (IMDG)	: 2 - Gases
MFAG-No	: 121

Air transport

UN-No. (IATA)	: 1046
Proper Shipping Name (IATA)	: Helium, compressed
Class (IATA)	: 2
Civil Aeronautics Law	: Gases under pressure/Gases nonflammable nontoxic under pressure

Helium, compressed

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SECTION 15: Regulatory information

15.1. US Federal regulations

Helium, compressed (7440-59-7)

Listed on the United States TSCA (Toxic Substances Control Act) inventory

SARA Section 311/312 Hazard Classes	Sudden release of pressure hazard
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All components of this product are listed on the Toxic Substances Control Act (TSCA) inventory.

This product or mixture does not contain a toxic chemical or chemicals in excess of the applicable de minimis concentration as specified in 40 CFR §372.38(a) subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

15.2. International regulations

CANADA

Helium, compressed (7440-59-7)

Listed on the Canadian DSL (Domestic Substances List)

Helium (7440-59-7)

Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Helium, compressed (7440-59-7)

Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Helium, compressed (7440-59-7)

Listed on the AICS (Australian Inventory of Chemical Substances)
Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)
Listed on the Korean ECL (Existing Chemicals List)
Listed on NZIoC (New Zealand Inventory of Chemicals)
Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)
Listed on INSQ (Mexican National Inventory of Chemical Substances)

15.3. US State regulations

Helium, compressed(7440-59-7)

U.S. - California - Proposition 65 - Carcinogens List	No
U.S. - California - Proposition 65 - Developmental Toxicity	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Female	No
U.S. - California - Proposition 65 - Reproductive Toxicity - Male	No
State or local regulations	U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

Helium (7440-59-7)

U.S. - California - Proposition 65 - Carcinogens List	U.S. - California - Proposition 65 - Developmental Toxicity	U.S. - California - Proposition 65 - Reproductive Toxicity - Female	U.S. - California - Proposition 65 - Reproductive Toxicity - Male	Non-significant risk level (NSRL)
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Helium, compressed

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Helium (7440-59-7)				
No	No	No	No	
Helium (7440-59-7)				
U.S. - Massachusetts - Right To Know List				
U.S. - New Jersey - Right to Know Hazardous Substance List				
U.S. - Pennsylvania - RTK (Right to Know) List				

SECTION 16: Other information

Other information

: When you mix two or more chemicals, you can 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 evaluate the end product. Before using any plastics, confirm their compatibility with this product

Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc, it is the user's obligation to determine the conditions of safe use of the product

Praxair SDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your Praxair sales representative, local distributor, or supplier, or download from www.praxair.com. If you have questions regarding Praxair SDSs, would like the document number and date of the latest SDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (Phone: 1-800-PRAXAIR/1-800-772-9247; Address: Praxair Call Center, Praxair, Inc, P.O. Box 44, Tonawanda, NY 14151-0044)

PRAXAIR and the Flowing Airstream design are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries.

NFPA health hazard

: 0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.

NFPA fire hazard

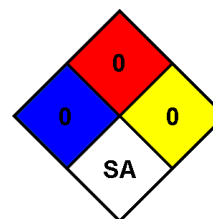
: 0 - Materials that will not burn.

NFPA reactivity

: 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.

NFPA specific hazard

: SA - This denotes gases which are simple asphyxiants.



HMIS III Rating

Health

: 0 Minimal Hazard - No significant risk to health

Flammability

: 0 Minimal Hazard

Physical

: 3 Serious Hazard

SDS US (GHS HazCom 2012) - Praxair

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

SAFETY DATA SHEET

SECTION 1:**PRODUCT AND COMPANY IDENTIFICATION**

Hydrochloric Acid, 31 – 36.7%

Product Name: Hydrochloric Acid, 31 – 36.7%

Identified Uses: acid etching, steel pickling, oil and gas, ore and mineral, food processing, pharmaceutical, organic chemical synthesis

Company Information:

ASHTA Chemicals Inc.

P.O. Box 858

Ashtabula Ohio 44005

Phone: (440) 997-5221

Fax: (440) 998-0286

24-hour Emergency Phone: CHEMTREC: (800) 424-9300

SECTION 2:**HAZARDS IDENTIFICATION**

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

GHS label elements, including precautionary statements:

Signal Word: **Danger**

Pictogram(s):

**Hazard Statements**

H290	May be corrosive to metals.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
H335	May cause respiratory irritation.

Precautionary Statements

P234	Keep only in original container.
P261	Avoid breathing dust/ fume/ mist/ vapors/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water. Shower.

P304 + P340 + P310	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/ physician.
P363	Wash contaminated clothing before reuse.
P390	Absorb spillage to prevent material damage.
P403 + P233	Store in a well-ventilated place. Keep container with a resistant inner liner.
P405	Store locked up.
P406	Store in corrosive resistant stainless steel container with a resistant inner liner.
P501	Dispose of contents/ container to an approved waste disposal plant.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Synonyms:

CHEMICAL NAME:	Hydrochloric acid
TRADE NAME:	Hydrochloric acid, 31 – 36.7%
SYNONYMS:	Muriatic acid, Chlorohydric acid, Hydrogen Chloride

C.A.S:	7647-01-0
EC:	231-595-7
WHMIS:	D2A, E

CHEMICAL FORMULA:	HCl (in aqueous solution)
CHEMICAL FAMILY:	Inorganic Acid

SECTION 4 FIRST AID MEASURES

Description of first aid measures:

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. If breathing is difficult, give humidified air. Give oxygen, but only by a certified physician. Consult a physician.

In case of skin contact

Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Remove contact lenses if present and easy to do. Continue rinsing eyes during transport to medical facility.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth thoroughly with water. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Consult a physician.

SECTION 5	FIRE FIGHTING MEASURES
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Flash Point (Method):	Non-combustible.
Extinguishing Media:	Use extinguishing agents compatible with acid and appropriate for the burning material. Use water spray to keep fire-exposed containers cool.
Auto Ignition Temp:	Non-combustible.
Special Fire Fighting Procedures:	Wear self-contained breathing apparatus and full protective clothing. In case of fire and/or explosion do not breathe fumes. Use standard firefighting procedures and consider the hazards of other involved materials.
Unusual Fire/Explosion Hazards:	Releases flammable hydrogen gas when reacting with metals.

SECTION 6	ACCIDENTAL RELEASE MEASURES
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Environmental Precautions:

Use closed systems when possible. Provide local exhaust ventilation where vapor or mist may be generated. Avoid discharge into drains, water courses or onto the ground.

Containment and Cleaning:

Follow preplanned emergency procedures. Only properly equipped, trained, functional personnel should attempt to contain a leak. All other personnel should be evacuated from the danger area. Using full protective equipment, apply appropriate emergency device or other securement technology to stop the leak if possible.

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. Stop leak if without risk. Do not touch spilled material. Use water spray curtain to knock down vapor drift. 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 vapor is not present at a concentration level above TLV.

SECTION 7:	HANDLING AND STORAGE
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Precautions to be taken for handling and storage:

Wear appropriate personal protective equipment. Do not get in eyes, on skin, on clothing. Do not breathe mist or vapor. Observe good industrial hygiene practices. Do not empty into drains. Use caution when combining with water; DO NOT add water to acid, ALWAYS add acid to water while stirring to prevent release of heat, steam and fumes. Store in a well-ventilated place. Store away from incompatible materials. Store closed containers in a clean, cool, open or well ventilated area. Keep out of sun.

SECTION 8: EXPOSURE CONTROL/PERSONAL PROTECTION

Principal Component: Hydrochloric Acid

Occupational Exposure Limits:

Regulatory Limits:

Component	OSHA Final PEL TWA	OSHA Final PEL STEL	OSHA Final PEL Ceiling
Hydrochloric Acid Mixture	---	---	5 ppm 7.59 mg/m ³

ACGIH TLV = 5 ppm (7.59 mg/m³) TWA

NIOSH IDLH = 50 ppm (as HCl, 2010)

Exposure Controls:

Eye Protection:

Tightly fitting safety goggles. Face shield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Respiratory Protection:

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multipurpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Other Protection:

Complete suit protecting against chemicals. The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Ventilation Recommended:

Exhaust ventilation is required to meet PEL limits.

Glove Type Recommended:

Wear neoprene, nitrile, butyl rubber or PVC gloves to prevent exposure.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties:

Appearance	Colorless to light yellow liquid
Odor	Pungent (irritating/strong)
Odor Threshold	0.3ppm (can cause olfactory fatigue)
pH	<1 (in aqueous solution)
Melting point/freezing point	-30°C (-22°F)
Initial boiling point	>100°C (>212°F)
Flash point	Not applicable
Auto-ignition Temp	Not applicable
Evaporation rate	No data available

Decomposition temperature	No data available
Flammability (solid, gas)	Not combustible
Upper/lower flammability or explosive limits	Not combustible
Water solubility	100%
Molecular Weight	36.46
Relative Density (Specific Gravity)	1.16 (32% HCl solution) 1.19 (36.5% HCl solution)
Bulk Density	8.75 lbs/gal (32% HCl solution) 9.83 lbs/gal (36.5% HCl solution)
Vapor Density (air = 1)	1.267 at 20 °C
Vapor Pressure	84 mm Hg @ 20°C
Partition Coefficient: n-octanol/water	No data available

SECTION 10:	STABILITY AND REACTIVITY
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Stability:	Hydrochloric acid is stable under normal conditions and pressures.
Conditions to avoid:	Incompatible materials, metals, excess heat, bases.
Incompatibility:	Bases, amines, metals, permanganates, (e.g. potassium permanganate), fluorine, metal acetylides, hexalithium disilicide.
Hazardous decomposition products:	Hydrogen chloride, chlorine, hydrogen gas.
Polymerization:	Hazardous polymerization WILL NOT occur.

SECTION 11:	TOXICOLOGICAL INFORMATION
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Information on likely routes of exposure:

Inhalation:	Vapors and mist will irritate throat and respiratory system and cause coughing.
Skin contact:	Causes skin burns.
Eye contact:	Causes eye burns.
Ingestion:	Harmful if swallowed. Causes digestive tract burns. Ingestion may produce burns to the lips, oral cavity, upper airway, esophagus and possibly the digestive tract.

Symptoms related to the physical, chemical and toxicological characteristics:

Contact with this material will cause burns to the skin, eyes and mucous membranes. Permanent eye damage including blindness could result.

Information on toxicological effects:

Acute toxicity:	Harmful if swallowed.
Skin corrosion/irritation:	Causes severe skin burns and eye damage.
Serious eye damage/eye irritation:	Causes serious eye damage.
Respiratory sensitization:	Not available.



Skin sensitization:	No data available.
Germ cell mutagenicity:	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity:	This product is not considered to be a carcinogen by IARC, ACGIH, NTP or OSHA.
Reproductive toxicity:	This product is not expected to cause reproductive or developmental effects.
Specific target organ toxicity - single exposure:	May cause respiratory irritation.
Specific target organ toxicity - repeated exposure:	No data available.
Aspiration hazard:	Not available.
Chronic effects:	Prolonged inhalation may be harmful.

Components Species Test Results:

Hydrochloric acid (CAS# 7647-01-0)

Rat - Inhalation LC ₅₀ :	3124 ppm, (1 hour)
Rabbit - Dermal LD ₅₀ :	5010 mg/kg

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity:	Because of the low pH of this product, it would be expected produce significant ecotoxicity upon exposure to aquatic organisms and aquatic systems.
Aquatic Toxicity:	This material is toxic to fish and aquatic organisms. Most aquatic species do not tolerate pH lower than 5.5 for any extended period.
Fish Toxicity:	Fish LC ₅₀ Mosquito fish: 282 mg/l, 96 hours Fish LC ₅₀ Bluegill: 3.6 mg/l, 48 hours
Persistence and degradability:	Not biodegradable. Hydrochloric acid will likely be neutralized to chloride by alkalinity present in natural environment..
Bioaccumulative Potential:	No data available.
Mobility in soil:	Hydrochloric acid will be neutralized by naturally occurring alkalinity. The acid will permeate soil, dissolving some soil material and will then neutralize.
Other adverse effects:	No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation)

SECTION 13: DISPOSAL CONSIDERATIONS

Collect and reclaim or dispose in sealed containers at a properly licensed waste disposal site. This material , if not neutralized, must be disposed of as hazardous waste. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national or international regulations.



SECTION 14:	TRANSPORT INFORMATION
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Shipping:

Usual Shipping Containers:	Tank cars, bulk tankers.
Usual Shelf Life:	Indefinite (life of containers).
Storage/Transport Temperatures:	Ambient.

Suitable Storage:

Materials/Coatings:	Teflon, Tygon, Rubber, PVC and polypropylene materials.
---------------------	---

D.O.T. Information:

Labeling:	Corrosive
D.O.T. Identification Number	UN 1789
D.O.T. Shipping Name:	Hydrochloric Acid
Hazard Class:	8
Packing Group:	II
Hazard Guide:	157
Placard:	UN 1789

SECTION 15	REGULATORY INFORMATION
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SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

Hydrochloric Acid	CAS#: 7647-01-0
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SARA 311/312 Hazards

Acute health hazard, reactive hazard.

Massachusetts Right To Know Components

Hydrochloric Acid	CAS#: 7647-01-0
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Pennsylvania Right To Know Components

Hydrochloric Acid	CAS#: 7647-01-0
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New Jersey Right To Know Components

Hydrochloric Acid	CAS#: 7647-01-0
-------------------	-----------------

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects or any other reproductive harm.

OSHA PSM TPQ:

CAS# 7647-01-0 is regulated under OSHA PSM *only* if anhydrous or >37% HCl.



Toxic Substances Control Act (TSCA):

Hydrochloric Acid

CAS#: 7647-01-0

Comprehensive Environmental Response Compensation Liability Act: (CERCLA)

Hydrochloric Acid

CAS#: 7647-01-0

SECTION 16

OTHER INFORMATION

NFPA Rating:

Health hazard: 3

Fire Hazard: 0

Reactivity Hazard: 1

This information is drawn from recognized sources believed to be reliable. ASHTA Chemicals, Inc. Makes no guarantees or assumes any liability in connection with this information. The user should be aware of changing technology, research, regulations, and analytical procedures that may require changes herein. The above data is supplied upon the condition that persons will evaluate this information and then determine its suitability for their use. Only U.S.A regulations apply to the above.

Version 1.0	For the new GHS SDS Standard
Version 1.1	Graphics updated
Version 1.2	Title updated
Version 1.3	Section 9 changes

Revision Date: 12/31/2014
Revision Date: 3/9/2015
Revision Date: 6/2/2015
Revision Date: 7/30/2015

SAFETY DATA SHEET



Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen


Section 1. Identification

GHS product identifier	: Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen
Other means of identification	: Not available.
Product use	: Synthetic/Analytical chemistry.
SDS #	: 002103
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
Emergency telephone number (with hours of operation)	: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms	: 
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Signal word	: Warning
Hazard statements	: Contains gas under pressure; may explode if heated.

Precautionary statements

General	: Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.
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Prevention	: Use and store only outdoors or in a well ventilated place.
-------------------	--

Response	: Not applicable.
-----------------	-------------------

Storage	: Protect from sunlight. Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.
----------------	---

Disposal	: Not applicable.
-----------------	-------------------

Hazards not otherwise classified	: None known.
---	---------------

Date of issue/Date of revision	: 1/23/2015.	Date of previous issue	: No previous validation.	Version	: 0.01	1/11
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Section 3. Composition/information on ingredients

Substance/mixture : Mixture
Other means of identification : Not available.

CAS number/other identifiers

CAS number : Not applicable.
Product code : 002103

Ingredient name	%	CAS number
Nitrogen	75 - 80.5	7727-37-9
oxygen	19.5 - 23.5	7782-44-7
2-methylpropene	0.0001 - 1.13	115-11-7

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Section 4. First aid measures

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use an extinguishing agent suitable for the surrounding fire.
- Unsuitable extinguishing media** : None known.

- Specific hazards arising from the chemical** : Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.
- Hazardous thermal decomposition products** : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
nitrogen oxides

- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

- Environmental precautions** : Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

- Small spill** : Immediately contact emergency personnel. Stop leak if without risk.
- Large spill** : 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

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. 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.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. 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).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Section 8. Exposure controls/personal protection

- Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory protection** : 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.

Section 9. Physical and chemical properties

Appearance

- Physical state** : Gas.
- Color** : Not available.
- Melting/freezing point** : -140.7°C (-221.3°F) This is based on data for the following ingredient: 2-methylpropene. Weighted average: -211.14°C (-348.1°F)
- Critical temperature** : Lowest known value: -146.95°C (-232.5°F) (nitrogen).
- Odor** : Not available.
- Odor threshold** : Not available.
- pH** : Not available.
- Flash point** : Not available.
- Burning time** : Not applicable.
- Burning rate** : Not applicable.
- Evaporation rate** : Not available.
- Flammability (solid, gas)** : Not available.
- Lower and upper explosive (flammable) limits** : Not available.
- Vapor pressure** : Not available.
- Vapor density** : Highest known value: 1.94 (Air = 1) (2-methylpropene). Weighted average: 1.01 (Air = 1)
- Gas Density (lb/ft³)** : Weighted average: 0.07
- Relative density** : Not applicable.
- Solubility** : Not available.
- Solubility in water** : Not available.
- Partition coefficient: n-octanol/water** : Not available.
- Auto-ignition temperature** : Not available.
- Decomposition temperature** : Not available.
- SADT** : Not available.
- Viscosity** : Not applicable.

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: No specific data.
Incompatibility with various substances	: Extremely reactive or incompatible with the following materials: reducing materials and combustible materials.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Section 11. Toxicological information

Potential acute health effects

- Eye contact** : Contact with rapidly expanding gas may cause burns or frostbite.
- Inhalation** : Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.
- Skin contact** : Contact with rapidly expanding gas may cause burns or frostbite.
- Ingestion** : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

- Eye contact** : No specific data.
- Inhalation** : No specific data.
- Skin contact** : No specific data.
- Ingestion** : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Long term exposure

- Potential immediate effects** : Not available.
- Potential delayed effects** : Not available.

Potential chronic health effects

Not available.

- General** : No known significant effects or critical hazards.
- Carcinogenicity** : No known significant effects or critical hazards.
- Mutagenicity** : No known significant effects or critical hazards.
- Teratogenicity** : No known significant effects or critical hazards.
- Developmental effects** : No known significant effects or critical hazards.
- Fertility effects** : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Section 12. Ecological information

Not available.

Mobility in soil






Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1956	UN1956	UN1956	UN1956	UN1956
UN proper shipping name	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	-	<u>Explosive Limit and Limited Quantity Index</u> 0.125 <u>Passenger Carrying Road or Rail Index</u> 75	-	-	-

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

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: Not determined
United States inventory (TSCA 8b): All components are listed or exempted.
Clean Air Act (CAA) 112 regulated flammable substances: 2-methylpropene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Sudden release of pressure

Composition/information on ingredients

No products were found.

State regulations

Massachusetts : The following components are listed: NITROGEN; OXYGEN (LIQUID); 2-METHYLPROPENE

New York : None of the components are listed.

New Jersey : The following components are listed: NITROGEN; OXYGEN; ISOBUTYLENE; 1-PROPENE, 2-METHYL-

Pennsylvania : The following components are listed: NITROGEN; OXYGEN; 1-PROPENE, 2-METHYL-

Canada inventory : All components are listed or exempted.

International regulations

International lists : **Australia inventory (AICS)**: All components are listed or exempted.
China inventory (IECSC): All components are listed or exempted.
Japan inventory: Not determined.
Korea inventory: All components are listed or exempted.
Malaysia Inventory (EHS Register): Not determined.
New Zealand Inventory of Chemicals (NZIoC): All components are listed or exempted.
Philippines inventory (PICCS): All components are listed or exempted.
Taiwan inventory (CSNN): Not determined.

Chemical Weapons Convention List Schedule I Chemicals : Not listed

Chemical Weapons Convention List Schedule II Chemicals : Not listed

Section 15. Regulatory information

Chemical Weapons Convention List Schedule III Chemicals : Not listed

Canada

WHMIS (Canada) : Class A: Compressed gas.
CEPA Toxic substances: None of the components are listed.
Canadian ARET: None of the components are listed.
Canadian NPRI: The following components are listed: Butene (all isomers)
Alberta Designated Substances: None of the components are listed.
Ontario Designated Substances: None of the components are listed.
Quebec Designated Substances: None of the components are listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

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

Health	1
Flammability	0
Physical hazards	0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on SDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

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



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Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

History

Date of printing : 1/23/2015.
Date of issue/Date of revision : 1/23/2015.
Date of previous issue : No previous validation.
Version : 0.01

Section 16. Other information

Key to abbreviations

- : ATE = Acute Toxicity Estimate
- BCF = Bioconcentration Factor
- GHS = Globally Harmonized System of Classification and Labelling of Chemicals
- IATA = International Air Transport Association
- IBC = Intermediate Bulk Container
- IMDG = International Maritime Dangerous Goods
- LogPow = logarithm of the octanol/water partition coefficient
- MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
- UN = United Nations
- ACGIH – American Conference of Governmental Industrial Hygienists
- AIHA – American Industrial Hygiene Association
- CAS – Chemical Abstract Services
- CEPA – Canadian Environmental Protection Act
- CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (EPA)
- CFR – United States Code of Federal Regulations
- CPR – Controlled Products Regulations
- DSL – Domestic Substances List
- GWP – Global Warming Potential
- IARC – International Agency for Research on Cancer
- ICAO – International Civil Aviation Organisation
- Inh – Inhalation
- LC – Lethal concentration
- LD – Lethal dosage
- NDSL – Non-Domestic Substances List
- NIOSH – National Institute for Occupational Safety and Health
- TDG – Canadian Transportation of Dangerous Goods Act and Regulations
- TLV – Threshold Limit Value
- TSCA – Toxic Substances Control Act
- WEEL – Workplace Environmental Exposure Level
- WHMIS – Canadian Workplace Hazardous Material Information System

References

- : Not available.

 Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

SAFETY DATA SHEET

Version 6.3
Revision Date 01/15/2020
Print Date 08/29/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking**1.1 Product identifiers**

Product name : Lead

Product Number : 396117

Brand : Aldrich

CAS-No. : 7439-92-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765

Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-
527-3887 CHEMTREC (International) 24
Hours/day; 7 Days/week

SECTION 2: Hazards identification**2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Acute toxicity, Oral (Category 4), H302
Carcinogenicity (Category 2), H351
Reproductive toxicity (Category 2), H361
Specific target organ toxicity - repeated exposure (Category 2), H373
Short-term (acute) aquatic hazard (Category 1), H400
Long-term (chronic) aquatic hazard (Category 1), H410

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word

Warning

Hazard statement(s)	
H302	Harmful if swallowed.
H351	Suspected of causing cancer.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.
H410	Very toxic to aquatic life with long lasting effects.
Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	: Pb
Molecular weight	: 207.2 g/mol
CAS-No.	: 7439-92-1
EC-No.	: 231-100-4

Component	Classification	Concentration
Lead		
	Acute Tox. 4; Carc. 2; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H372, H400, H410 M-Factor - Aquatic Acute: 10	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Lead oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Avoid breathing dust.

For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid formation of dust and aerosols. Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Storage class (TRGS 510): 6.1D: Non-combustible, acute toxic Cat.3 / toxic hazardous materials or hazardous materials causing chronic effects

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
	Remarks	See 1910.1025		
Lead	7439-92-1	TWA	0.05 mg/m ³	USA. ACGIH Threshold Limit Values (TLV)
		Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m ³	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Hematologic effects Peripheral Nervous System impairment Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m ³	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
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Lead	7439-92-1	Lead	200 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Safety glasses with side-shields conforming to EN166 Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0.11 mm

Break through time: 480 min

Material tested: Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection

Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.
Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a) Appearance	Form: Shot
b) Odour	No data available
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 327.4 °C (621.3 °F) - lit.
f) Initial boiling point and boiling range	1,740 °C 3,164 °F - lit.
g) Flash point	()Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	No data available
n) Water solubility	No data available
o) Partition coefficient: n-octanol/water	No data available
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

No data available

10.5 Incompatible materials

Strong acids

10.6 Hazardous decomposition products

Other decomposition products - No data available

Hazardous decomposition products formed under fire conditions. - Lead oxides
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

No data available

Inhalation: No data available

Dermal: No data available

No data available

Skin corrosion/irritation

No data available

Serious eye damage/eye irritation

No data available

Respiratory or skin sensitisation

No data available

Germ cell mutagenicity

Rat

Cytogenetic analysis

Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Lead)

NTP: RAHC - Reasonably anticipated to be a human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Lead)

OSHA: OSHA specifically regulated carcinogen (Lead)

Reproductive toxicity

May damage fertility. May damage the unborn child.

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard

No data available

Additional Information

RTECS: OF7525000

anemia

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	mortality LOEC - <i>Oncorhynchus mykiss</i> (rainbow trout) - 1.19 mg/l - 96.0 h
	LC50 - <i>Micropterus dolomieu</i> - 2.2 mg/l - 96.0 h
	mortality NOEC - <i>Salvelinus fontinalis</i> - 1.7 mg/l - 10.0 d
Toxicity to daphnia and other aquatic invertebrates	mortality LOEC - <i>Daphnia</i> (water flea) - 0.17 mg/l - 24 h
	mortality NOEC - <i>Daphnia</i> (water flea) - 0.099 mg/l - 24 h
Toxicity to algae	mortality EC50 - <i>Skeletonema costatum</i> - 7.94 mg/l - 10 d

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

Bioaccumulation *Oncorhynchus kisutch* - 2 Weeks
- 150 µg/l(Lead)

Bioconcentration factor (BCF): 12

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Very toxic to aquatic life with long lasting effects.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix

the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.

Contaminated packaging

Dispose of as unused product.

SECTION 14: Transport information

DOT (US)

UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead)
Reportable Quantity (RQ): 10 lbs
Poison Inhalation Hazard: No

IMDG

UN number: 3077 Class: 9 Packing group: III EMS-No: F-A, S-F
Proper shipping name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Lead)
Marine pollutant : yes

IATA

UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Lead)

Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

SECTION 15: Regulatory information

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Lead	7439-92-1	2015-11-23

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	2015-11-23

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	2015-11-23

New Jersey Right To Know Components

Lead

CAS-No.
7439-92-1Revision Date
2015-11-23**California Prop. 65 Components**

WARNING! This product contains a chemical known to the State of California to cause cancer. Lead

CAS-No.
7439-92-1Revision Date
2009-02-01

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Lead

CAS-No.
7439-92-1Revision Date
2009-02-01

SECTION 16: Other information**Further information**

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Version: 6.3

Revision Date: 01/15/2020

Print Date: 08/29/2020

SAFETY DATA SHEET

Version 6.4
Revision Date 01/15/2020
Print Date 08/29/2020

SECTION 1: Identification of the substance/mixture and of the company/undertaking**1.1 Product identifiers**

Product name : Manganese

Product Number : 266167
Brand : Aldrich
CAS-No. : 7439-96-5

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 Spruce Street
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-
527-3887 CHEMTREC (International) 24
Hours/day; 7 Days/week

SECTION 2: Hazards identification**2.1 Classification of the substance or mixture****GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Short-term (acute) aquatic hazard (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram none

Signal word none

Hazard statement(s)
H401 Toxic to aquatic life.

Precautionary statement(s)
P273 Avoid release to the environment.
P501 Dispose of contents/ container to an approved waste disposal

plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula : Mn
Molecular weight : 54.94 g/mol
CAS-No. : 7439-96-5
EC-No. : 231-105-1

Component	Classification	Concentration
Manganese		
	Aquatic Acute 2; H401	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Manganese/manganese oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Further processing of solid materials may result in the formation of combustible dusts. The potential for combustible dust formation should be taken into consideration before additional processing occurs.

Provide appropriate exhaust ventilation at places where dust is formed.

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place.

Moisture sensitive. Handle and store under inert gas.

Storage class (TRGS 510): 13: Non Combustible Solids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Manganese	7439-96-5	C	5 mg/m ³	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
	Remarks	Ceiling limit is to be determined from breathing-zone air		

		samples.		
		TWA	1 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	3 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	5 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		Ceiling limit is to be determined from breathing-zone air samples.		
		PEL	0.2 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		STEL	3 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		TWA	0.1 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Not classifiable as a human carcinogen varies		
		TWA	0.02 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Not classifiable as a human carcinogen varies		

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection

Choose body protection in relation to its type, to the concentration and amount of dangerous substances, and to the specific work-place., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Respiratory protection is not required. Where protection from nuisance levels of dusts are desired, use type N95 (US) or type P1 (EN 143) dust masks. Use

respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a) Appearance	Form: chips Colour: grey, brown, silver
b) Odour	odourless
c) Odour Threshold	No data available
d) pH	No data available
e) Melting point/freezing point	Melting point/range: 1,244 °C (2,271 °F) - lit.
f) Initial boiling point and boiling range	1,962 °C 3,564 °F - lit.
g) Flash point	()Not applicable
h) Evaporation rate	No data available
i) Flammability (solid, gas)	No data available
j) Upper/lower flammability or explosive limits	No data available
k) Vapour pressure	No data available
l) Vapour density	No data available
m) Relative density	7.3 g/mL at 25 °C (77 °F)
n) Water solubility	0.0007 g/l at 20 °C (68 °F)
o) Partition coefficient: n-octanol/water	Not applicable for inorganic substances
p) Auto-ignition temperature	No data available
q) Decomposition temperature	No data available
r) Viscosity	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

No data available

SECTION 10: Stability and reactivity

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

No data available

10.4 Conditions to avoid

Avoid moisture.

10.5 Incompatible materials

acids, Halogens, Bases, Phosphorus, Sulphur oxides, Hydrogen peroxide, Oxidizing agents, Nitric acid, Sodium Hydroxide, Carbon dioxide (CO₂), Nitryl Flouride, Steam

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Manganese/manganese oxides

Other decomposition products - No data available

In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - female - > 2,000 mg/kg

(OECD Test Guideline 420)

LC50 Inhalation - Rat - male and female - 4 h - > 5.14 mg/l

(OECD Test Guideline 403)

Dermal: No data available

No data available

Skin corrosion/irritation

Skin - Rabbit

Result: No skin irritation

(OECD Test Guideline 404)

Serious eye damage/eye irritation

Eyes - Rabbit

Result: No eye irritation - 72 h

(OECD Test Guideline 405)

Respiratory or skin sensitisation

- Mouse

Result: Does not cause skin sensitisation.

(OECD Test Guideline 429)

Germ cell mutagenicity

No data available

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

- NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.
- OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

Reproductive toxicity

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

Additional Information

RTECS: Not available

Men exposed to manganese dusts showed a decrease in fertility. Chronic manganese poisoning primarily involves the central nervous system. Early symptoms include languor, sleepiness and weakness in the legs. A stolid mask-like appearance of the face, emotional disturbances such as uncontrollable laughter and a spastic gait with tendency to fall in walking are findings in more advanced cases. High incidence of pneumonia has been found in workers exposed to the dust or fume of some manganese compounds., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

SECTION 12: Ecological information**12.1 Toxicity**

Toxicity to fish	semi-static test NOEC - Oncorhynchus mykiss (rainbow trout) - 3.6 mg/l - 96 h (OECD Test Guideline 203) Remarks: No toxicity at the limit of solubility
Toxicity to daphnia and other aquatic invertebrates	Immobilization NOEC - Daphnia magna (Water flea) - 1.6 mg/l - 48 h (OECD Test Guideline 202) Remarks: No toxicity at the limit of solubility
Toxicity to algae	Growth inhibition EC50 - Desmodesmus subspicatus (green algae) - 4.5 mg/l - 72 h (OECD Test Guideline 201)
Toxicity to bacteria	Respiration inhibition EC50 - Sludge Treatment - 1,000 mg/l - 3 h (OECD Test Guideline 209)

12.2 Persistence and degradability

The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life.

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

SECTION 14: Transport information

DOT (US)

Not dangerous goods

IMDG

Not dangerous goods

IATA

Not dangerous goods

SECTION 15: Regulatory information

SARA 302 Components

This material does not contain any components with a section 302 EHS TPQ.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Manganese	7439-96-5	2007-07-01

SARA 311/312 Hazards

Chronic Health Hazard

Massachusetts Right To Know Components

Manganese

CAS-No.
7439-96-5

Revision Date
2007-07-01

Pennsylvania Right To Know Components

Manganese

CAS-No.
7439-96-5

Revision Date
2007-07-01

California Prop. 65 Components

This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

SECTION 16: Other information

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Version: 6.4

Revision Date: 01/15/2020

Print Date: 08/29/2020

SAFETY DATA SHEET

According to US Regulation 29 CFR 1910.1200 (HazCom 2012)

1. Identification

Product identifier: Tetrachloroethylene

Other means of identification

Product No.: 1933, 9360, 9453, 9465, 9469

Recommended restrictions

Recommended use: For Laboratory, Research or Manufacturing Use.

Restrictions on use: Not determined.

Details of the supplier of the safety data sheet

Company Name: Avantor Performance Materials, LLC
Address: 100 Matsonford Rd, Suite 200
Radnor, PA 19087

Telephone: Customer Service: 855-282-6867

Contact Person: Product Information Compliance
E-mail: info@avantormaterials.com

Emergency telephone number:

CHEMTREC: 1-800-424-9300 within US and Canada (24 hrs/day, 7 days/week)

2. Hazard(s) identification

Hazard Classification

Health Hazards

Carcinogenicity Category 2

Unknown toxicity - Health

Acute toxicity, dermal 100 %

Environmental Hazards

Acute hazards to the aquatic environment Category 2

Chronic hazards to the aquatic environment Category 2

Unknown toxicity - Environment

Acute hazards to the aquatic environment 0 %

Chronic hazards to the aquatic environment 100 %

Label Elements

Hazard Symbol:

SDS_US - SDS000000890



Signal Word: Warning

Hazard Statement: Suspected of causing cancer.
Toxic to aquatic life with long lasting effects.

Precautionary Statements

Prevention: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves/protective clothing/eye protection/face protection. Avoid release to the environment.

Response: IF exposed or concerned: Get medical advice/attention. Collect spillage.

Storage: Store locked up.

Disposal: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

Hazard(s) not otherwise classified (HNOC): None.

3. Composition/information on ingredients

Substances

Chemical Identity	CAS number	Content in percent (%)*
Tetrachloroethylene	127-18-4	99 - 100%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

General information: Get medical advice/attention if you feel unwell. Show this safety data sheet to the doctor in attendance.

Ingestion: Rinse mouth thoroughly. Call a physician or poison control center immediately.

Inhalation: Move to fresh air. Get medical attention if symptoms occur.

Skin Contact: Wash skin thoroughly with soap and water. Get medical attention if irritation persists after washing. Wash contaminated clothing before reuse.

Eye contact: Flush thoroughly with water. If irritation occurs, get medical assistance.

Most important symptoms/effects, acute and delayed

Symptoms: Irritating to eyes, respiratory system and skin.

Hazards: None known.

Indication of immediate medical attention and special treatment needed

Treatment: Treat symptomatically. Symptoms may be delayed.

5. Fire-fighting measures

General Fire Hazards: Fire may produce irritating, corrosive and/or toxic gases.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media: Use fire-extinguishing media appropriate for surrounding materials.

Unsuitable extinguishing media: None known.

Specific hazards arising from the chemical: During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters

Special fire fighting procedures: Move containers from fire area if you can do so without risk. Use water spray to keep fire-exposed containers cool. Cool containers exposed to flames with water until well after the fire is out.

Special protective equipment for fire-fighters: Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Keep unauthorized personnel away. Ventilate closed spaces before entering them. Use personal protective equipment. See Section 8 of the SDS for Personal Protective Equipment. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.

Methods and material for containment and cleaning up: Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Clean surface thoroughly to remove residual contamination.

Notification Procedures: Prevent entry into waterways, sewer, basements or confined areas. Stop the flow of material, if this is without risk. Inform authorities if large amounts are involved.

Environmental Precautions: Prevent further leakage or spillage if safe to do so. Avoid release to the environment.

7. Handling and storage

Precautions for safe handling: Use personal protective equipment as required. Do not handle until all safety precautions have been read and understood. Obtain special instructions before use. Do not get in eyes, on skin, on clothing. Do not eat, drink or smoke when using the product. Wash hands thoroughly after handling.

Conditions for safe storage, including any incompatibilities: Keep container tightly closed. Store in a cool, dry place with adequate ventilation. Keep away from incompatible materials, open flames, and high temperatures. Should be stored separately from oxidizers, bases, and food chemical substances

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	Type	Exposure Limit Values	Source
Tetrachloroethylene	TWA	25 ppm	US. ACGIH Threshold Limit Values (2011)
	STEL	100 ppm	US. ACGIH Threshold Limit Values (2011)
	TWA	25 ppm 170 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	TWA	100 ppm	US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
	Ceiling	200 ppm	US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
	MAX. CONC	300 ppm	US. OSHA Table Z-2 (29 CFR 1910.1000) (02 2006)
	TWA	25 ppm 170 mg/m3	US. Tennessee. OELs. Occupational Exposure Limits, Table Z1A (06 2008)
	AN ESL	Health 3.8 ppb	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (06 2018)
	AN ESL	Health 26 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (06 2018)
	ST ESL	Health 2,000 µg/m3	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (06 2018)
	ST ESL	Health 290 ppb	US. Texas. Effects Screening Levels (Texas Commission on Environmental Quality) (06 2018)
	Ceiling	300 ppm	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (08 2010)
	STEL	100 ppm 685 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (08 2010)
	TWA PEL	25 ppm 170 mg/m3	US. California Code of Regulations, Title 8, Section 5155. Airborne Contaminants (08 2010)

Biological Limit Values

Chemical Identity	Exposure Limit Values	Source
Tetrachloroethylene (tetrachloroethylene: Sampling time: Prior to shift.)	0.5 mg/l (Blood)	ACGIH BEI (03 2013)
	(End-exhaled air)	ACGIH BEI (03 2013)

Appropriate Engineering Controls

No data available.

Individual protection measures, such as personal protective equipment

General information: Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. An eye wash and safety shower must be available in the immediate work area.

Eye/face protection: Wear safety glasses with side shields (or goggles) and a face shield.

Skin Protection

Hand Protection:

Chemical resistant gloves

Other:	Wear suitable protective clothing.
Respiratory Protection:	In case of inadequate ventilation use suitable respirator.
Hygiene measures:	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing to remove contaminants. Discard contaminated footwear that cannot be cleaned. Provide eyewash station and safety shower. Do not handle until all safety precautions have been read and understood. Obtain special instructions before use.

9. Physical and chemical properties

Appearance

Physical state:	Liquid
Form:	Liquid
Color:	Colorless
Odor:	Ether-like odor
Odor threshold:	No data available.
pH:	Not applicable
Melting point/freezing point:	-22 - -19 °C
Initial boiling point and boiling range:	121 - 121.4 °C
Flash Point:	Not applicable
Evaporation rate:	No data available.
Flammability (solid, gas):	No data available.
Upper/lower limit on flammability or explosive limits	
Flammability limit - upper (%):	No data available.
Flammability limit - lower (%):	No data available.
Explosive limit - upper (%):	No data available.
Explosive limit - lower (%):	No data available.
Vapor pressure:	1.9 kPa (20 °C) 2.47 - 2.5 kPa (25 °C) 58.5 kPa (100 °C)
Vapor density:	5.7 (Air=1)
Density:	1.62 g/ml (20 °C)
Relative density:	1.62 (20 °C)
Solubility(ies)	
Solubility in water:	0.15 g/l (25 °C)
Solubility (other):	chloroform: Miscible ether: Miscible hexane: Miscible alcohol: Miscible
Partition coefficient (n-octanol/water):	3.40
Auto-ignition temperature:	No data available.
Decomposition temperature:	No data available.
Viscosity:	No data available.
Other information	
Molecular weight:	165.83 g/mol (C ₂ Cl ₄)

10. Stability and reactivity

Reactivity:	No dangerous reaction known under conditions of normal use.
Chemical Stability:	Material is stable under normal conditions.

Possibility of hazardous reactions:	Hazardous polymerization does not occur.
Conditions to avoid:	Heat. Light. Moisture. Contact with incompatible materials.
Incompatible Materials:	Strong oxidizing agents. Strong acids. Strong alkalis.
Hazardous Decomposition Products:	Thermal decomposition may release oxides of carbon. Hydrogen Chloride. Phosgene.

11. Toxicological information

Information on likely routes of exposure

Inhalation:	None known or expected under normal use.
Skin Contact:	Prolonged skin contact may cause temporary irritation.
Eye contact:	May cause temporary eye irritation.
Ingestion:	None known or expected under normal use.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral	
Product:	LD 50 (Rat): 3,005 - 3,835 mg/kg
Dermal	
Product:	No data available.
Inhalation	
Product:	LC 50 (Rat, 8 h) 5000 ppm

Repeated dose toxicity	
Product:	No data available.

Skin Corrosion/Irritation	
Product:	Prolonged skin contact may cause temporary irritation.

Serious Eye Damage/Eye Irritation	
Product:	May cause temporary eye irritation.

Respiratory or Skin Sensitization	
Product:	Not a skin nor a respiratory sensitizer.

Carcinogenicity	
Product:	May cause cancer.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:

Tetrachloroethylene Overall evaluation: 2A. Probably carcinogenic to humans.

US. National Toxicology Program (NTP) Report on Carcinogens:

Tetrachloroethylene Reasonably Anticipated to be a Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):

No carcinogenic components identified

Germ Cell Mutagenicity

In vitro

Product: No mutagenic components identified

In vivo

Product: No mutagenic components identified

Reproductive toxicity

Product: No data available.

Specific Target Organ Toxicity - Single Exposure

Product: None known.

Specific Target Organ Toxicity - Repeated Exposure

Product: None known.

Aspiration Hazard

Product: Not classified

Other effects: None known.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product: No data available.

Specified substance(s):

Tetrachloroethylene
LC 50 (Bluegill Sunfish, 96 h): 11 - 15 mg/l
LC 50 (Inland silverside (Menidia beryllina), 96 h): 27.3 - 28.9 mg/l
EC 50 (Rainbow Trout, 96 h): 4.68 - 5 mg/l
LC 50 (Fathead Minnow, 96 h): 13.4 - 23.8 mg/l
LC 50 (Flagfish (Jordanella floridae), 96 h): 8.4 mg/l

Aquatic Invertebrates

Product: No data available.

Specified substance(s):

Tetrachloroethylene
EC 50 (Water flea (Daphnia magna), 48 h): 6.1 - 22 mg/l
LC 50 (Water flea (Daphnia magna), 48 h): 7.7 - 18 mg/l
EC 50 (Paratanytarsus dissimilis, 48 h): 28.7 - 33 mg/l
EC 50 (Elminius modestus, 48 h): 3.5 mg/l

Chronic hazards to the aquatic environment:

Fish

Product: No data available.

Aquatic Invertebrates

Product: No data available.

Toxicity to Aquatic Plants

Product: No data available.

Persistence and Degradability

Biodegradation

Product: Not readily degradable.

BOD/COD Ratio

Product: No data available.

Bioaccumulative potential

Bioconcentration Factor (BCF)

Product: The product is not bioaccumulating.

Partition Coefficient n-octanol / water (log Kow)

Product: Log Kow: 3.40

Mobility in soil: No data available.

Other adverse effects: Toxic to aquatic life with long lasting effects.

13. Disposal considerations

Disposal instructions: Discharge, treatment, or disposal may be subject to national, state, or local laws.

Contaminated Packaging: Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN Number:	UN 1897
UN Proper Shipping Name:	Tetrachloroethylene
Transport Hazard Class(es)	
Class:	6.1
Label(s):	6.1
Packing Group:	III
Marine Pollutant:	Yes

Special precautions for user: Not determined.

IMDG

UN Number: UN 1897
UN Proper Shipping Name: TETRACHLOROETHYLENE
Transport Hazard Class(es)
Class: 6.1
Label(s): 6.1
EmS No.: F-A, S-A
Packing Group: III
Marine Pollutant: Yes
Special precautions for user: Not determined.

IATA

UN Number: UN 1897
Proper Shipping Name: Tetrachloroethylene
Transport Hazard Class(es):
Class: 6.1
Label(s): 6.1
Packing Group: III
Marine Pollutant: Yes
Special precautions for user: Not determined.

15. Regulatory information

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

None present or none present in regulated quantities.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

<u>Chemical Identity</u>	<u>Reportable quantity</u>
Tetrachloroethylene	100 lbs.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories

Carcinogenicity

SARA 302 Extremely Hazardous Substance

None present or none present in regulated quantities.

SARA 304 Emergency Release Notification

None present or none present in regulated quantities.

SARA 311/312 Hazardous Chemical

<u>Chemical Identity</u>	<u>Threshold Planning Quantity</u>
Tetrachloroethylene	10000 lbs.

SARA 313 (TRI Reporting)

<u>Chemical Identity</u>	<u>Reporting threshold for other users</u>	<u>Reporting threshold for manufacturing and processing</u>
Tetrachloroethylene	10000 lbs.	25000 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3):

None present or none present in regulated quantities.

US State Regulations
US. California Proposition 65

WARNING: This product contains a chemical known to the State of California to cause cancer.
Tetrachloroethylene Carcinogenic.

US. New Jersey Worker and Community Right-to-Know Act
Chemical Identity

Tetrachloroethylene

US. Massachusetts RTK - Substance List
Chemical Identity

Tetrachloroethylene

US. Pennsylvania RTK - Hazardous Substances
Chemical Identity

Tetrachloroethylene

US. Rhode Island RTK
Chemical Identity

Tetrachloroethylene

International regulations
Montreal protocol

Not applicable

Stockholm convention

Not applicable

Rotterdam convention

Not applicable

Kyoto protocol

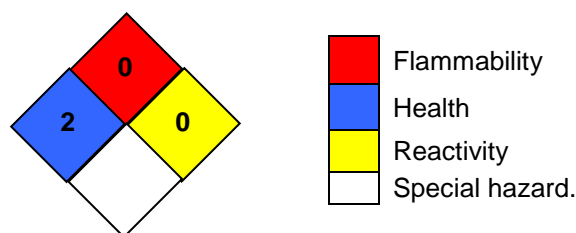
Not applicable

Inventory Status:

Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
China Inv. Existing Chemical Substances:	On or in compliance with the inventory
Japan (ENCS) List:	On or in compliance with the inventory
Japan ISHL Listing:	On or in compliance with the inventory
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Mexico INSQ:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Philippines PICCS:	On or in compliance with the inventory
Taiwan Chemical Substance Inventory:	On or in compliance with the inventory
US TSCA Inventory:	On or in compliance with the inventory
EINECS, ELINCS or NLP:	On or in compliance with the inventory

16. Other information, including date of preparation or last revision

NFPA Hazard ID



Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible

Issue Date: 01-30-2020

Revision Information: Not relevant.

Version #: 1.1

Source of information: Sources of information used in preparing this SDS included one or more of the following: results from in house or supplier toxicology studies, information from the Toxicology Data Network (TOXNET), European Chemical Agency (ECHA) substance dossiers, IARC Monographs, US National Toxicology Program data, the Agency for Toxic Substances and Disease Registry, other manufacturer's SDSs and other sources, as appropriate.

Further Information: No data available.

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SAFETY DATA SHEET

Creation Date 03-Dec-2010

Revision Date 18-Jan-2018

Revision Number 6

1. Identification

Product Name Phenol

Cat No. : A92-100, A92-212, A92-500

CAS-No 108-95-2

Synonyms Carbolic acid; Hydroxybenzene

Recommended Use Laboratory chemicals.

Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company

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

Emergency Telephone Number

CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification

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

Acute oral toxicity	Category 3
Acute dermal toxicity	Category 3
Acute Inhalation Toxicity - Dusts and Mists	Category 3
Skin Corrosion/irritation	Category 1 B
Serious Eye Damage/Eye Irritation	Category 1
Germ Cell Mutagenicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	
Specific target organ toxicity - (repeated exposure)	Category 1
Target Organs - Liver, Kidney, Blood, Central nervous system (CNS).	

Label Elements

Signal Word

Danger

Hazard Statements

Toxic if swallowed
Toxic in contact with skin
Toxic if inhaled
Causes severe skin burns and eye damage
May cause respiratory irritation

May cause drowsiness or dizziness
Suspected of causing genetic defects
Causes damage to organs through prolonged or repeated exposure



Precautionary Statements

Prevention

Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Use only outdoors or in a well-ventilated area
Do not breathe dust/fume/gas/mist/vapors/spray
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep cool

Response

Immediately call a POISON CENTER or doctor/physician

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Skin

Wash contaminated clothing before reuse
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower

Eyes

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing

Ingestion

Rinse mouth
Do NOT induce vomiting

Fire

In case of fire: Use CO₂, dry chemical, or foam for extinction

Storage

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

Disposal

Dispose of contents/container to an approved waste disposal plant

Hazards not otherwise classified (HNOC)

Toxic to aquatic life with long lasting effects
Combustible material

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Phenol	108-95-2	>95

4. First-aid measures

Eye Contact

Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
Immediate medical attention is required.

Skin Contact

Wash off immediately with plenty of water for at least 15 minutes. Immediate medical

	attention is required.
Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.
Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	Breathing difficulties. Causes burns by all exposure routes. . Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting: Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: May cause central nervous system depression
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	No information available
Flash Point	79 °C / 174.2 °F
Method -	No information available
Autoignition Temperature	605 °C / 1121 °F
Explosion Limits	
Upper	8.6 vol %
Lower	1.7 vol %
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Combustible material. Risk of ignition. Containers may explode when heated. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO₂)

Protective Equipment and Precautions for Firefighters

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

NFPA

Health	Flammability	Instability	Physical hazards
4	2	1	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Remove all sources of ignition. Ensure adequate ventilation. Avoid contact with skin, eyes and clothing. Avoid dust formation. Take precautionary measures against static discharges.
Environmental Precautions	Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
Methods for Containment and Clean Up	Remove all sources of ignition. Sweep up and shovel into suitable containers for disposal. Avoid dust formation. Use spark-proof tools and explosion-proof equipment.

7. Handling and storage

Handling	Use only under a chemical fume hood. Wear personal protective equipment. Avoid dust formation. Do not breathe dust. Do not get in eyes, on skin, or on clothing. Keep away from open flames, hot surfaces and sources of ignition.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Protect from moisture. Protect from light. Corrosives area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Phenol	TWA: 5 ppm Skin	(Vacated) TWA: 5 ppm (Vacated) TWA: 19 mg/m ³ Skin TWA: 5 ppm TWA: 19 mg/m ³	IDLH: 250 ppm TWA: 5 ppm TWA: 19 mg/m ³ Ceiling: 15.6 ppm Ceiling: 60 mg/m ³	TWA: 5 ppm TWA: 19 mg/m ³ STEL: 10 ppm STEL: 38 mg/m ³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists

OSHA - Occupational Safety and Health Administration

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

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

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Effective dust mask Filter type A.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Crystalline Solid
Appearance	Colorless - Translucent White
Odor	pungent
Odor Threshold	No information available
pH	6 @ 20°C 10 g/L aq.sol
Melting Point/Range	39 - 42 °C / 102.2 - 107.6 °F
Boiling Point/Range	182 °C / 359.6 °F @ 760 mmHg
Flash Point	79 °C / 174.2 °F
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	8.6 vol %
Lower	1.7 vol %
Vapor Pressure	0.4 mbar @ 20 °C
Vapor Density	Not applicable
Specific Gravity	1.070
Solubility	Soluble in water

Partition coefficient; n-octanol/water
 Autoignition Temperature
 Decomposition Temperature
 Viscosity
 Molecular Formula
 Molecular Weight

No data available
 605 °C / 1121 °F
 No information available
 3.437 mPa.s (50°C)
 C6 H6 O
 94.11

10. Stability and reactivity

Reactive Hazard	Yes
Stability	Hygroscopic, Light sensitive.
Conditions to Avoid	Avoid dust formation. Incompatible products. Exposure to moisture. Exposure to light. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Acids, Bases, Strong oxidizing agents, Halogens, lead, Metals
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO ₂)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Phenol	Calc. ATE 60 mg/kg (Human evidence) LD50 = 340 mg/kg (Rat) 650 mg/kg (Rat; OECD 401)	Calc. ATE 300 mg/kg (Human evidence) LD50 = 660 mg/kg (Rat) 850 - 1400 mg/kg (Rabbit)	Calc. ATE 0.5 mg/l (Human evidence) LC50 >900 mg/m ³ /8h (Rat)

Toxicologically Synergistic Products No information available

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

Irritation	Causes burns by all exposure routes
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Phenol	108-95-2	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system
STOT - repeated exposure Liver Kidney Blood Central nervous system (CNS)

Aspiration hazard No information available

Symptoms / effects, both acute and Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting:

delayed

Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated: Ingestion causes severe swelling, severe damage to the delicate tissue and danger of perforation: May cause central nervous system depression

Endocrine Disruptor Information

No information available

Other Adverse Effects

Tumorigenic effects have been reported in experimental animals. See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Phenol	EC50: 187 - 279 mg/L, 72h static (Desmodesmus subspicatus) EC50: 0.0188 - 0.1044 mg/L, 96h static (Pseudokirchneriella subcapitata) EC50: = 46.42 mg/L, 96h (Pseudokirchneriella subcapitata)	4-7 mg/L LC50 96 h 32 mg/L LC50 96 h	EC50 21 - 36 mg/L 30 min EC50 = 23.28 mg/L 5 min EC50 = 25.61 mg/L 15 min EC50 = 28.8 mg/L 5 min EC50 = 31.6 mg/L 15 min	EC50: 10.2 - 15.5 mg/L, 48h (Daphnia magna) EC50: 4.24 - 10.7 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability

Soluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation

No information available.

Mobility

Will likely be mobile in the environment due to its water solubility.

Component	log Pow
Phenol	1.5

13. Disposal considerations

Waste Disposal Methods

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

Component	RCRA - U Series Wastes	RCRA - P Series Wastes
Phenol - 108-95-2	U188	-

14. Transport information

DOT

UN-No UN1671
Proper Shipping Name PHENOL, SOLID
Hazard Class 6.1
Packing Group II

TDG

UN-No UN1671
Proper Shipping Name PHENOL, SOLID
Hazard Class 6.1
Packing Group II

IATA

UN-No UN1671
Proper Shipping Name PHENOL, SOLID
Hazard Class 6.1
Packing Group II

IMDG/IMO

UN-No	UN1671
Proper Shipping Name	PHENOL, SOLID
Hazard Class	6.1
Packing Group	II

15. Regulatory information

All of the components in the product are on the following Inventory lists: Australia Complete Regulatory Information contained in following SDS's X = listed China Canada The product is classified and labeled according to EC directives or corresponding national laws The product is classified and labeled in accordance with Directive 1999/45/EC TSCA Korea Philippines Japan U.S.A. (TSCA) Canada (DSL/NDSL) Europe (EINECS/ELINCS/NLP) Australia (AICS) Korea (ECL) China (IECSC) Japan (ENCS) Philippines (PICCS)

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Phenol	X	X	-	203-632-7	-		X	X	X	X	X

Legend:

X - Listed

E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.

F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.

N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.

P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.

S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.

XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B)).

Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Phenol	108-95-2	>95	1.0

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

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Phenol	X	1000 lb	X	X

Clean Air Act

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

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA

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

Component	Hazardous Substances RQs	CERCLA EHS RQs
Phenol	1000 lb	1000 lb

California Proposition 65

This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

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

U.S. Department of Transportation

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

U.S. Department of Homeland Security

This product does not contain any DHS chemicals.

Other International Regulations**Mexico - Grade**

No information available

16. Other information**Prepared By**

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

Creation Date

03-Dec-2010

Revision Date

18-Jan-2018

Print Date

18-Jan-2018

Revision Summary

This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Material Safety Data Sheet

Trichloroethylene

ACC# 23850

Section 1 - Chemical Product and Company Identification

MSDS Name: Trichloroethylene**Catalog Numbers:** AC158310000, AC158310025, AC421520000, AC421520040, AC421520200, AC421525000, 15831-0010, S80327ACS-1, S80327ACS-2, T340-4, T341-20, T341-4, T341-500, T341J4, T403-4**Synonyms:** Ethylene trichloride; 1,1,2-Trichloroethylene; TCE.**Company Identification:**

Fisher Scientific

1 Reagent Lane

Fair Lawn, NJ 07410

For information, call: 201-796-7100**Emergency Number:** 201-796-7100**For CHEMTREC assistance, call:** 800-424-9300**For International CHEMTREC assistance, call:** 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
79-01-6	Trichloroethylene	99+	201-167-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: APHA: 15 max liquid.

Warning! Harmful to aquatic organisms; may cause long-term adverse effects in the aquatic environment. Breathing vapors may cause drowsiness and dizziness. Possible risks of irreversible effects. Cancer hazard. Causes eye and skin irritation. May cause respiratory tract irritation. May cause liver and kidney damage. May cause central nervous system effects.**Target Organs:** Kidneys, central nervous system, liver, spleen, respiratory system, eyes, skin.

Potential Health Effects

Eye: Causes eye irritation. Contact with trichloroethylene causes pain but no permanent injury to the eyes. (Doc of TLV)**Skin:** Causes skin irritation. May be harmful if absorbed through the skin.**Ingestion:** May cause irritation of the digestive tract. May be harmful if swallowed. May cause central nervous system effects.**Inhalation:** May cause respiratory tract irritation. May cause liver and kidney damage. May be harmful if inhaled. May cause central nervous system effects. The chief symptoms of TCE exposure were found to be abnormal fatigue, irritability, headache, gastric disturbances, and intolerance to alcohol. (Doc to TLV)**Chronic:** Prolonged or repeated skin contact may cause defatting and dermatitis. May cause liver and kidney damage. May cause cancer in humans. Repeated exposure may cause damage to the spleen. Adverse reproductive effects have been reported in animals. Laboratory experiments have resulted in mutagenic effects. Possible risk of irreversible effects.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid.

Skin: Get medical aid. Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.

Ingestion: Do not induce vomiting. Get medical aid.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician: Treat symptomatically and supportively.

Section 5 - Fire Fighting Measures

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

Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.

Flash Point: Not applicable.

Autoignition Temperature: 410 deg C (770.00 deg F)

Explosion Limits, Lower: 7.9 Vol %

Upper: 90 Vol %

NFPA Rating: (estimated) Health: 2; Flammability: 1; Instability: 1

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Absorb spill with inert material (e.g. vermiculite, sand or earth), then place in suitable container. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section). Remove all sources of ignition. Use a spark-proof tool. Do not let this chemical enter the environment.

Section 7 - Handling and Storage

Handling: Do not get in eyes, on skin, or on clothing. Keep away from heat, sparks and flame. Do not ingest or inhale. Use only in a chemical fume hood.

Storage: Keep away from sources of ignition. Store in a cool, dry place. Store in a tightly closed container. Store protected from light.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use only under a chemical fume hood.

Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Trichloroethylene	10 ppm TWA; 25 ppm STEL	1000 ppm IDLH	100 ppm TWA; 200 ppm Ceiling

OSHA Vacated PELs: Trichloroethylene: 50 ppm TWA; 270 mg/m³ TWA

Personal Protective Equipment

Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin: Wear appropriate protective gloves to prevent skin exposure.

Clothing: Wear appropriate protective clothing to prevent skin exposure.

Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Liquid

Appearance: clear, colorless - APHA: 15 max

Odor: chloroform-like

pH: Not available.

Vapor Pressure: 77.3 mbar @ 20 deg C

Vapor Density: 4.5 (air=1)

Evaporation Rate: Not available.

Viscosity: Not available.

Boiling Point: 87 deg C @ 760 mmHg

Freezing/Melting Point: -86 deg C

Decomposition Temperature: Not available.

Solubility: Insoluble.

Specific Gravity/Density: 1.460

Molecular Formula: C₂HCl₃

Molecular Weight: 131.39

Section 10 - Stability and Reactivity

Chemical Stability: Moisture sensitive. Light sensitive.

Conditions to Avoid: Incompatible materials, light, ignition sources, excess heat, exposure to moist air or water.

Incompatibilities with Other Materials: Strong oxidizing agents, strong reducing agents, bases, active metals, metals and metal compounds (toxic, e.g. beryllium, lead acetate, nickel carbonyl, tetraethyl lead).

Hazardous Decomposition Products: Hydrogen chloride, carbon monoxide, carbon dioxide.

Hazardous Polymerization: Will not occur.

Section 11- Toxicological Information

RTECS#:

CAS# 79-01-6: KX4550000

LD50/LC50:

CAS# 79-01-6:

Draize test, rabbit, eye: 20 mg/24H Moderate;

Draize test, rabbit, skin: 2 mg/24H Severe;

Inhalation, mouse: LC50 = 8450 ppm/4H;

Inhalation, mouse: LC50 = 220000 mg/m³/20M;

Inhalation, mouse: LC50 = 262000 mg/m³/30M;

Inhalation, mouse: LC50 = 40000 mg/m³/4H;

Inhalation, rat: LC50 = 140700 mg/m³/1H;

Oral, mouse: LD50 = 2402 mg/kg;

Oral, mouse: LD50 = 2400 mg/kg;

Oral, rat: LD50 = 4920 mg/kg;

Skin, rabbit: LD50 = >20 gm/kg;

Skin, rabbit: LD50 = 20 mL/kg;

Carcinogenicity:

CAS# 79-01-6:

- **ACGIH:** A2 - Suspected Human Carcinogen
- **California:** carcinogen, initial date 4/1/88
- **NTP:** Suspect carcinogen
- **IARC:** Group 2A carcinogen

Epidemiology: Tumorigenic effects have been reported in experimental animals.

Teratogenicity: Teratogenic effects have occurred in experimental animals.

Reproductive Effects: Adverse reproductive effects have occurred in experimental animals.

Mutagenicity: Mutagenic effects have occurred in humans.

Neurotoxicity: No information available.

Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Fish: Fathead Minnow: 41-67 mg/L; 96 hrs.; LC50Daphnia: Daphnia: 2.2-100 mg/L; 48 hrs.; LC50Mollusk Shrimp: 2 mg/L; 96 hrs.; LC50 Bluegill sunfish, LD50= 44,700 ug/L/96Hr. Fathead minnow, LC50=40.7 mg/L/96Hr.

Environmental: In air, substance is photooxidized and is reported to form phosgene, dichloroacetyl chloride, and formyl chloride. In water, it evaporates rapidly. Potential for mobility in soil is high.

Physical: No information available.

Other: Bioconcentration potential is low (BCF less than 100).

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.

RCRA P-Series: None listed.

RCRA U-Series:

CAS# 79-01-6: waste number U228.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	TRICHLOROETHYLENE	TRICHLOROETHYLENE
Hazard Class:	6.1	6.1
UN Number:	UN1710	UN1710
Packing Group:	III	III

Section 15 - Regulatory Information

US FEDERAL

TSCA

CAS# 79-01-6 is listed on the TSCA inventory.

Health & Safety Reporting List

None of the chemicals are on the Health & Safety Reporting List.

Chemical Test Rules

None of the chemicals in this product are under a Chemical Test Rule.

Section 12b

None of the chemicals are listed under TSCA Section 12b.

TSCA Significant New Use Rule

None of the chemicals in this material have a SNUR under TSCA.

CERCLA Hazardous Substances and corresponding RQs

CAS# 79-01-6: 100 lb final RQ; 45.4 kg final RQ

SARA Section 302 Extremely Hazardous Substances

None of the chemicals in this product have a TPQ.

SARA Codes

CAS # 79-01-6: immediate, delayed, reactive.

Section 313

This material contains Trichloroethylene (CAS# 79-01-6, 99+%), which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR

Clean Air Act:

CAS# 79-01-6 is listed as a hazardous air pollutant (HAP).

This material does not contain any Class 1 Ozone depleters.

This material does not contain any Class 2 Ozone depleters.

Clean Water Act:

CAS# 79-01-6 is listed as a Hazardous Substance under the CWA. CAS# 79-01-6 is listed as a Priority Pollutant under the Clean Water Act. CAS# 79-01-6 is listed as a Toxic Pollutant under the Clean Water Act.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 79-01-6 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, Massachusetts.

California Prop 65**The following statement(s) is(are) made in order to comply with the California Safe Drinking Water Act:**

WARNING: This product contains Trichloroethylene, a chemical known to the state of California to cause cancer.

California No Significant Risk Level: CAS# 79-01-6: 50 µg/day NSRL (oral); 80 µg/day NSRL (inhalation)

European/International Regulations**European Labeling in Accordance with EC Directives****Hazard Symbols:**

T

Risk Phrases:

R 36/38 Irritating to eyes and skin.

R 45 May cause cancer.

R 52/53 Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

R 67 Vapours may cause drowsiness and dizziness.

R 68 Possible risk of irreversible effects.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 53 Avoid exposure - obtain special instructions before use.

S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 79-01-6: 3

Canada - DSL/NDSL

CAS# 79-01-6 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D1B, D2B.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 79-01-6 is listed on the Canadian Ingredient Disclosure List.

<h2>Section 16 - Additional Information</h2>
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MSDS Creation Date: 2/01/1999

Revision #9 Date: 6/03/2008

The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall Fisher be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if Fisher has been advised of the possibility of such damages.

SAFETY DATA SHEET

Version 5.6
Revision Date 09/23/2016
Print Date 09/29/2018

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Residual Solvent - Toluene

Product Number : PHR1317
Brand : Sigma-Aldrich
Index-No. : 601-021-00-3

CAS-No. : 108-88-3

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Skin irritation (Category 2), H315
Reproductive toxicity (Category 2), H361
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
Specific target organ toxicity - repeated exposure (Category 2), H373
Aspiration hazard (Category 1), H304
Acute aquatic toxicity (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal word : Danger

Hazard statement(s)

H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H336	May cause drowsiness or dizziness.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.
H401	Toxic to aquatic life.

Precautionary statement(s)	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233	Keep container tightly closed.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ ventilating/ lighting/ equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P260	Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTER/doctor.
P303 + P361 + P353	IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304 + P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P321	Specific treatment (see supplemental first aid instructions on this label).
P331	Do NOT induce vomiting.
P332 + P313	If skin irritation occurs: Get medical advice/ attention.
P362	Take off contaminated clothing and wash before reuse.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam for extinction.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
P403 + P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Synonyms	: Toluene
Formula	: C ₇ H ₈
Molecular weight	: 92.14 g/mol
CAS-No.	: 108-88-3
EC-No.	: 203-625-9
Index-No.	: 601-021-00-3
Registration number	: 01-2119471310-51-XXXX

Hazardous components

Component	Classification	Concentration
Toluene		
	Flam. Liq. 2; Skin Irrit. 2; Repr. 2; STOT SE 3; STOT RE 2; Asp. Tox. 1; Aquatic Acute 2; H225, H304, H315, H336, H361, H373, H401	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Flush eyes with water as a precaution.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media

Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture

No data available

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

Use water spray to cool unopened containers.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Use personal protective equipment. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up

Contain spillage, and then collect with an electrically protected vacuum cleaner or by wet-brushing and place in container for disposal according to local regulations (see section 13).

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Store at Room Temperature.

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Toluene	108-88-3	TWA	100 ppm 375 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		STEL	150 ppm 560 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		TWA	200 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
	Remarks	Z37.12-1967		
		CEIL	300 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.12-1967		
		Peak	500 ppm	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.12-1967		
		TWA	20 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Visual impairment Female reproductive Pregnancy loss 2015 Adoption Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen		
		TWA	100 ppm 375 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	150 ppm 560 mg/m3	USA. NIOSH Recommended Exposure Limits

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Toluene	108-88-3	Toluene	0.0200 mg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to last shift of workweek			
		Toluene	0.0300 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			
		o-Cresol	0.3000 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of shift (As soon as possible after exposure ceases)			

8.2 Exposure controls

Appropriate engineering controls

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection

Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

- | | |
|---|--|
| a) Appearance | Form: liquid
Colour: colourless |
| b) Odour | aromatic |
| c) Odour Threshold | No data available |
| d) pH | No data available |
| e) Melting point/freezing point | -93.0 °C (-135.4 °F) |
| f) Initial boiling point and boiling range | 110.6 °C (231.1 °F) |
| g) Flash point | 4.0 °C (39.2 °F) - closed cup |
| h) Evaporation rate | No data available |
| i) Flammability (solid, gas) | No data available |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 7 %(V)
Lower explosion limit: 1.2 %(V) |
| k) Vapour pressure | 29.1 hPa (21.8 mmHg) at 20.0 °C (68.0 °F) |
| l) Vapour density | No data available |
| m) Relative density | 0.86 g/cm ³ at 25.00 °C (77.00 °F) |
| n) Water solubility | 0.5 g/l at 15 °C (59 °F) |
| o) Partition coefficient: n-octanol/water | No data available |
| p) Auto-ignition | 535.0 °C (995.0 °F) |

temperature

- | | |
|------------------------------|-------------------|
| q) Decomposition temperature | No data available |
| r) Viscosity | No data available |
| s) Explosive properties | No data available |
| t) Oxidizing properties | No data available |

9.2 Other safety information

No data available

10. STABILITY AND REACTIVITY

10.1 Reactivity

No data available

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

Vapours may form explosive mixture with air.

10.4 Conditions to avoid

Heat, flames and sparks. Extremes of temperature and direct sunlight.

10.5 Incompatible materials

Strong oxidizing agents

10.6 Hazardous decomposition products

Other decomposition products - No data available

Hazardous decomposition products formed under fire conditions. - Carbon oxides

In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - > 5,580 mg/kg

LC50 Inhalation - Rat - 4 h - 12,500 - 28,800 mg/m³

LD50 Dermal - Rabbit - 12,196 mg/kg

No data available

Skin corrosion/irritation

Skin - Rabbit

Result: Skin irritation - 24 h

Serious eye damage/eye irritation

Eyes - Rabbit

Result: No eye irritation

(OECD Test Guideline 405)

Respiratory or skin sensitisation

No data available

Germ cell mutagenicity

Rat

Liver

DNA damage

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a

known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA.

Reproductive toxicity

Damage to fetus possible

Suspected human reproductive toxicant

Reproductive toxicity - Rat - Inhalation

Paternal Effects: Spermatogenesis (including genetic material, sperm morphology, motility, and count).

Experiments have shown reproductive toxicity effects in male and female laboratory animals.

Developmental Toxicity - Rat - Oral

Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus).

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

Additional Information

RTECS: XS5250000

Lung irritation, chest pain, pulmonary edema, Inhalation studies on toluene have demonstrated the development of inflammatory and ulcerous lesions of the penis, prepuce, and scrotum in animals., Central nervous system

Stomach - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Oncorhynchus mykiss (rainbow trout) - 7.63 mg/l - 96 h
	NOEC - Pimephales promelas (fathead minnow) - 5.44 mg/l - 7 d
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 8.00 mg/l - 24 h
	Immobilization EC50 - Daphnia magna (Water flea) - 6 mg/l - 48 h
Toxicity to algae	EC50 - Chlorella vulgaris (Fresh water algae) - 245.00 mg/l - 24 h
	EC50 - Pseudokirchneriella subcapitata (green algae) - 10.00 mg/l - 24 h

12.2 Persistence and degradability

Biodegradability Result: - Readily biodegradable

12.3 Bioaccumulative potential

Bioaccumulation Leuciscus idus (Golden orfe) - 3 d
- 0.05 mg/l

Bioconcentration factor (BCF): 90

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product

Contact a licensed professional waste disposal service to dispose of this material. Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company.

Contaminated packaging

Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1294 Class: 3 Packing group: II
Proper shipping name: Toluene
Reportable Quantity (RQ): 1000 lbs

Poison Inhalation Hazard: No

IMDG

UN number: 1294 Class: 3 Packing group: II EMS-No: F-E, S-D
Proper shipping name: TOLUENE

IATA

UN number: 1294 Class: 3 Packing group: II
Proper shipping name: Toluene

15. REGULATORY INFORMATION

SARA 302 Components

No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

	CAS-No.	Revision Date
Toluene	108-88-3	2007-07-01

SARA 311/312 Hazards

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Toluene	108-88-3	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Toluene	108-88-3	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Toluene	108-88-3	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.	108-88-3	2009-02-01
Toluene		

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Asp. Tox.	Aspiration hazard
Flam. Liq.	Flammable liquids
H225	Highly flammable liquid and vapour.
H304	May be fatal if swallowed and enters airways.
H315	Causes skin irritation.
H336	May cause drowsiness or dizziness.
H361	Suspected of damaging fertility or the unborn child.
H373	May cause damage to organs through prolonged or repeated exposure.
H401	Toxic to aquatic life.
Repr.	Reproductive toxicity
Skin Irrit.	Skin irritation

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	3
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	3
Reactivity Hazard:	0

Further information

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The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 5.6

Revision Date: 09/23/2016

Print Date: 09/29/2018

SAFETY DATA SHEET

Xylenes

Airgas
an Air Liquide company

Section 1. Identification

GHS product identifier	: Xylenes
Chemical name	: xylene
Other means of identification	: Benzene, dimethyl-; Xylol; xylene, mixed isomers, pure; xylene, crude; Benzene, dimethyl-; Xylene (mixed); Xylenes; Dimethylbenzene; XYLENES (Isomer Mixture); XYLENE, mixture of isomers; Benzene,dimethyl-(mixed)
Product type	: Liquid.
Product use	: Synthetic/Analytical chemistry.
Synonym	: Benzene, dimethyl-; Xylol; xylene, mixed isomers, pure; xylene, crude; Benzene, dimethyl-; Xylene (mixed); Xylenes; Dimethylbenzene; XYLENES (Isomer Mixture); XYLENE, mixture of isomers; Benzene,dimethyl-(mixed)
SDS #	: 001064
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
24-hour telephone	: 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: FLAMMABLE LIQUIDS - Category 3 ACUTE TOXICITY (dermal) - Category 4 ACUTE TOXICITY (inhalation) - Category 4 SKIN IRRITATION - Category 2 EYE IRRITATION - Category 2A SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (inhalation) - Category 2 ASPIRATION HAZARD - Category 1 AQUATIC HAZARD (ACUTE) - Category 2

GHS label elements

Hazard pictograms



Signal word

: Danger

Hazard statements

: Flammable liquid and vapor.
May form explosive mixtures with air.
Harmful in contact with skin or if inhaled.
Causes serious eye irritation.
Causes skin irritation.
May be fatal if swallowed and enters airways.
May cause respiratory irritation.
May cause damage to organs through prolonged or repeated exposure if inhaled.
Toxic to aquatic life.

Precautionary statements

General

: Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand.

Section 2. Hazards identification

- Prevention** : Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Do not breathe vapor. Wash hands thoroughly after handling.
- Response** : Get medical attention if you feel unwell. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF ON SKIN: Wash with plenty of soap and water. Call a POISON CENTER or physician if you feel unwell. Take off contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.
- Storage** : Store locked up. Store in a well-ventilated place. Keep cool.
- Disposal** : Dispose of contents and container in accordance with all local, regional, national and international regulations.
- Hazards not otherwise classified** : None known.

Section 3. Composition/information on ingredients

- Substance/mixture** : Substance
- Chemical name** : xylene
- Other means of identification** : Benzene, dimethyl-; Xylol; xylene, mixed isomers, pure; xylene, crude; Benzene, dimethyl-; Xylene (mixed); Xylenes; Dimethylbenzene; XYLENES (Isomer Mixture); XYLENE, mixture of isomers; Benzene,dimethyl-(mixed)
- Product code** : 001064

CAS number/other identifiers

- CAS number** : 1330-20-7

Ingredient name	%	CAS number
xylene	100	1330-20-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

- Eye contact** : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention.
- Inhalation** : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Section 4. First aid measures

- Skin contact** : Wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Get medical attention. If necessary, call a poison center or physician. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Stop if the exposed person feels sick as vomiting may be dangerous. Aspiration hazard if swallowed. Can enter lungs and cause damage. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

- Eye contact** : Causes serious eye irritation.
- Inhalation** : Harmful if inhaled. May cause respiratory irritation.
- Skin contact** : Harmful in contact with skin. Causes skin irritation.
- Frostbite** : Try to warm up the frozen tissues and seek medical attention.
- Ingestion** : May be fatal if swallowed and enters airways.

Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following: pain or irritation, watering, redness
- Inhalation** : Adverse symptoms may include the following: respiratory tract irritation, coughing
- Skin contact** : Adverse symptoms may include the following: irritation, redness
- Ingestion** : Adverse symptoms may include the following: nausea or vomiting

Indication of immediate medical attention and special treatment needed, if necessary

- Notes to physician** : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.
- Specific treatments** : No specific treatment.
- Protection of first-aiders** : 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. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

- Suitable extinguishing media** : Use dry chemical, CO₂, water spray (fog) or foam.
- Unsuitable extinguishing media** : Do not use water jet.

- Specific hazards arising from the chemical** : Flammable liquid and vapor. Runoff to sewer may create fire or explosion hazard. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. This material is toxic to aquatic life. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.

Section 5. Fire-fighting measures

- Hazardous thermal decomposition products** : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
- Special protective actions for fire-fighters** : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".
- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities.

Methods and materials for containment and cleaning up

- Small spill** : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
- Large spill** : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

- Protective measures** : Put on appropriate personal protective equipment (see Section 8). Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Avoid release to the environment. Avoid contact with eyes, skin and clothing. Empty containers retain product residue and can be hazardous. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Do not reuse container. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Do not breathe vapor or mist. Do not swallow.

Section 7. Handling and storage

Advice on general occupational hygiene

: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities

: Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Store locked up. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination. See Section 10 for incompatible materials before handling or use.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
xylene	<p>ACGIH TLV (United States, 3/2017). STEL: 651 mg/m³ 15 minutes. STEL: 150 ppm 15 minutes. TWA: 434 mg/m³ 8 hours. TWA: 100 ppm 8 hours.</p> <p>OSHA PEL (United States, 6/2016). TWA: 435 mg/m³ 8 hours. TWA: 100 ppm 8 hours.</p> <p>OSHA PEL 1989 (United States, 3/1989). STEL: 655 mg/m³ 15 minutes. STEL: 150 ppm 15 minutes. TWA: 435 mg/m³ 8 hours. TWA: 100 ppm 8 hours.</p>

Appropriate engineering controls

: Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls

: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures

: Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection

: Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Section 8. Exposure controls/personal protection

- Hand protection** : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.
- Body protection** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.
- Other skin protection** : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory protection** : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Section 9. Physical and chemical properties

Appearance

- Physical state** : Liquid. [COLORLESS LIQUID WITH AROMATIC ODOR]
- Color** : Colorless.
- Odor** : Aromatic.
- Odor threshold** : Not available.
- pH** : Not available.
- Melting point** : -94.96°C (-138.9°F)
- Boiling point** : 136.16°C (277.1°F)
- Critical temperature** : Not available.
- Flash point** : Closed cup: 18°C (64.4°F)
- Evaporation rate** : 0.77 (butyl acetate = 1)
- Flammability (solid, gas)** : Not available.
- Lower and upper explosive (flammable) limits** : Lower: 0.8%
Upper: 6.7%
- Vapor pressure** : 0.89 kPa (6.7 mm Hg) [room temperature]
- Vapor density** : 3.7 (Air = 1)
- Specific Volume (ft³/lb)** : 1.1628
- Gas Density (lb/ft³)** : 0.86 (25°C / 77 to °F)
- Relative density** : 0.861
- Solubility** : Not available.
- Solubility in water** : 0.15 g/l
- Partition coefficient: n-octanol/water** : 3.12
- Auto-ignition temperature** : 432°C (809.6°F)
- Decomposition temperature** : Not available.
- Viscosity** : Dynamic (room temperature): 0.58 mPa·s (0.58 cP)
- Flow time (ISO 2431)** : Not available.
- Molecular weight** : 106.17 g/mole
- Aerosol product**
- Heat of combustion** : -40839908 J/kg

Section 10. Stability and reactivity

- Reactivity** : No specific test data related to reactivity available for this product or its ingredients.
- Chemical stability** : The product is stable.
- Possibility of hazardous reactions** : Under normal conditions of storage and use, hazardous reactions will not occur.
- Conditions to avoid** : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.
- Incompatible materials** : Reactive or incompatible with the following materials:
oxidizing materials
- Hazardous decomposition products** : Under normal conditions of storage and use, hazardous decomposition products should not be produced.
- Hazardous polymerization** : Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
xylene	LC50 Inhalation Gas. LD50 Oral	Rat Rat	5000 ppm 4300 mg/kg	4 hours -

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
xylene	Skin - Mild irritant	Rat	-	8 hours 60 microliters	-
	Skin - Moderate irritant	Rabbit	-	24 hours 500 milligrams	-
	Skin - Moderate irritant	Rabbit	-	100 Percent	-
	Eyes - Mild irritant	Rabbit	-	87 milligrams	-
	Eyes - Severe irritant	Rabbit	-	24 hours 5 milligrams	-

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Classification

Product/ingredient name	OSHA	IARC	NTP
xylene	-	3	-

Reproductive toxicity

Not available.

Teratogenicity

Section 11. Toxicological information

Not available.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
xylene	Category 3	Not applicable.	Respiratory tract irritation

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
xylene	Category 2	Inhalation	Not determined

Aspiration hazard

Name	Result
xylene	ASPIRATION HAZARD - Category 1

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Causes serious eye irritation.
Inhalation : Harmful if inhaled. May cause respiratory irritation.
Skin contact : Harmful in contact with skin. Causes skin irritation.
Ingestion : May be fatal if swallowed and enters airways.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : Adverse symptoms may include the following: pain or irritation, watering, redness
Inhalation : Adverse symptoms may include the following: respiratory tract irritation, coughing
Skin contact : Adverse symptoms may include the following: irritation, redness
Ingestion : Adverse symptoms may include the following: nausea or vomiting

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : May cause damage to organs through prolonged or repeated exposure if inhaled.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Section 11. Toxicological information

Not available.

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
xylene	Acute LC50 8500 µg/l Marine water	Crustaceans - Palaemonetes pugio	48 hours
	Acute LC50 13400 µg/l Fresh water	Fish - Pimephales promelas	96 hours

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	LogP _{ow}	BCF	Potential
xylene	3.12	8.1 to 25.9	low

Mobility in soil

Soil/water partition coefficient (K_{oc}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations






Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Xylene	1330-20-7	Listed	U239

Section 14. Transport information

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1307	UN1307	UN1307	UN1307	UN1307
UN proper shipping name	XYLENES	XYLENES	XYLENES	XYLENES	XYLENES
Transport hazard class(es)	3 	3 	3 	3 	3 
Packing group	III	III	III	III	III
Environmental hazards	No.	No.	No.	No.	No.

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

Additional information

DOT Classification

- : **Reportable quantity** 100 lbs / 45.4 kg [13.946 gal / 52.791 L]. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
- : **Limited quantity** Yes.
- : **Quantity limitation** Passenger aircraft/rail: 5 L. Cargo aircraft: 60 L.
- : **Special provisions** IB2, T4, TP1

TDG Classification

- : Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.18-2.19 (Class 3).

IATA

- : **Quantity limitation** Passenger and Cargo Aircraft: 5 L. Cargo Aircraft Only: 60 L. Limited Quantities - Passenger Aircraft: 1 L.

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : TSCA 8(a) CDR Exempt/Partial exemption: Not determined
Clean Water Act (CWA) 311: xylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Section 15. Regulatory information

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Refer to Section 2: Hazards Identification of this SDS for classification of substance.

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	xylene	1330-20-7	100
Supplier notification	xylene	1330-20-7	100

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : This material is listed.

New York : This material is listed.

New Jersey : This material is listed.

Pennsylvania : This material is listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Inventory list

Australia : This material is listed or exempted.

Canada : This material is listed or exempted.

China : This material is listed or exempted.

Europe : This material is listed or exempted.

Japan : **Japan inventory (ENCS)**: This material is listed or exempted.
Japan inventory (ISHL): This material is listed or exempted.

Malaysia : This material is listed or exempted.

New Zealand : This material is listed or exempted.

Philippines : This material is listed or exempted.

Republic of Korea : This material is listed or exempted.

Taiwan : This material is listed or exempted.

Thailand : Not determined.

Turkey : This material is listed or exempted.

United States : This material is listed or exempted.

Viet Nam : Not determined.

Section 16. Other information

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

Health	*	2
Flammability		3
Physical hazards		0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks. Although HMIS® ratings and the associated label are not required on SDSs or products leaving a facility under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered trademark and service mark of the American Coatings Association, Inc.

The customer is responsible for determining the PPE code for this material. For more information on HMIS® Personal Protective Equipment (PPE) codes, consult the HMIS® Implementation Manual.

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



Reprinted with permission from NFPA 704-2001, Identification of the Hazards of Materials for Emergency Response Copyright ©1997, National Fire Protection Association, Quincy, MA 02269. This reprinted material is not the complete and official position of the National Fire Protection Association, on the referenced subject which is represented only by the standard in its entirety.

Copyright ©2001, National Fire Protection Association, Quincy, MA 02269. This warning system is intended to be interpreted and applied only by properly trained individuals to identify fire, health and reactivity hazards of chemicals. The user is referred to certain limited number of chemicals with recommended classifications in NFPA 49 and NFPA 325, which would be used as a guideline only. Whether the chemicals are classified by NFPA or not, anyone using the 704 systems to classify chemicals does so at their own risk.

Procedure used to derive the classification

Classification	Justification
FLAMMABLE LIQUIDS - Category 3	Expert judgment
ACUTE TOXICITY (dermal) - Category 4	Expert judgment
ACUTE TOXICITY (inhalation) - Category 4	On basis of test data
SKIN IRRITATION - Category 2	Expert judgment
EYE IRRITATION - Category 2A	On basis of test data
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3	Expert judgment
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (inhalation) - Category 2	Expert judgment
ASPIRATION HAZARD - Category 1	Expert judgment
AQUATIC HAZARD (ACUTE) - Category 2	Expert judgment

History

Date of printing : 12/27/2017

Date of issue/Date of revision : 12/27/2017

Date of previous issue : 2/9/2017

Version : 0.02

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL = International Convention for the Prevention of Pollution From Ships, 1973

Section 16. Other information

as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References

: Not available.

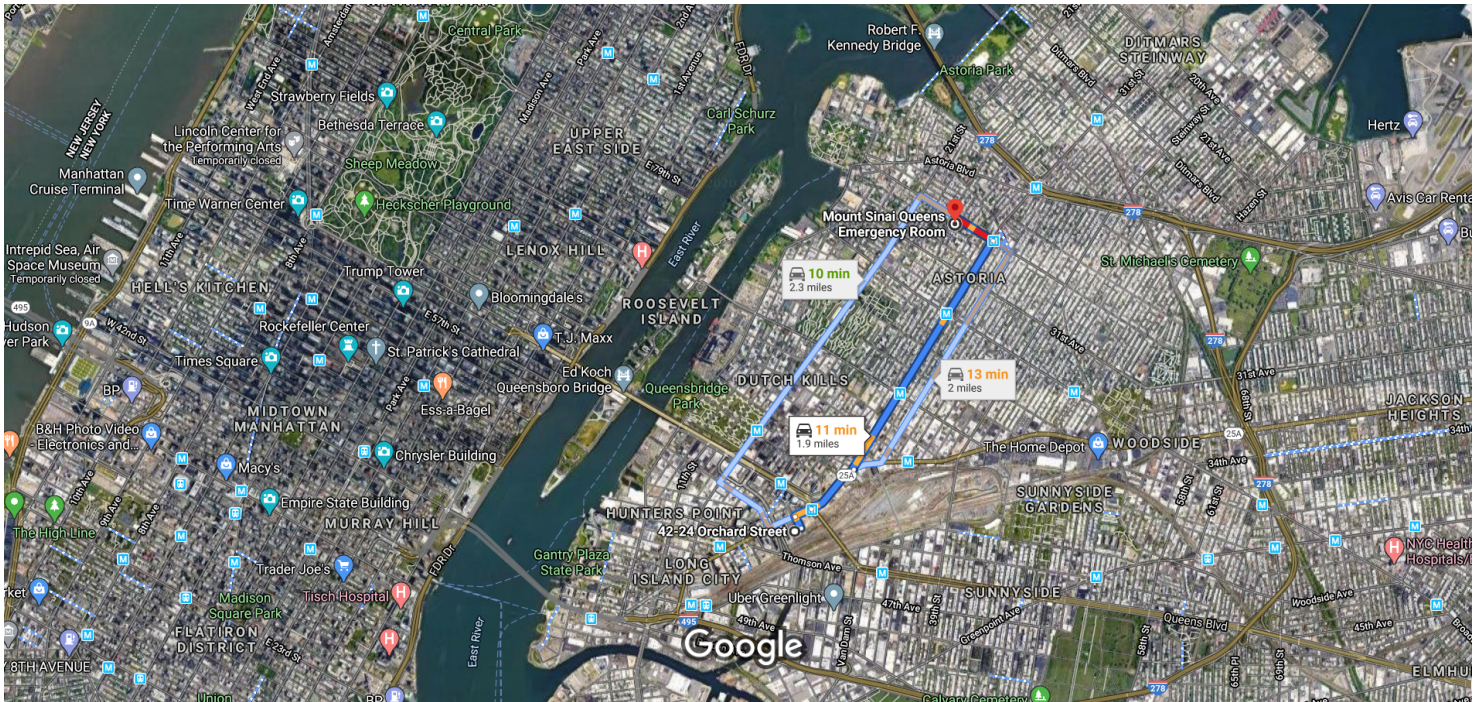
Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Attachment C
Hospital Route



Imagery ©2020 Bluesky, CNES / Airbus, Landsat / Copernicus, Maxar Technologies, Sanborn, USDA Farm Service Agency, Map data ©2020 Google

2000 ft

42-24 Orchard St

Long Island City, NY 11101

- ↑ 1. Head northwest on Orchard St toward Jackson Ave
325 ft
- ➡ 2. Turn right onto Jackson Ave
427 ft
- ↑ 3. Continue onto Northern Blvd/Quees Plaza E
Continue to follow Northern Blvd
0.3 mi
- ↙ 4. Slight left onto 31st St
Pass by Subway (on the right in 0.4 mi)
1.2 mi
- ↶ 5. Turn left onto 30th Ave
Destination will be on the left
0.2 mi

Mount Sinai Queens Emergency Room

3019 Crescent Street at, 30th Rd, 11102

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Attachment D
Work Care Information

EARLY INCIDENT INTERVENTION®

Immediate Access to Medical Advice for Work Related Incidents

(888) 449-7787

INTRODUCTION

WorkCare, Inc. (WorkCare) and TRC have partnered together to promote Incident Intervention®, a resource designed to support company safety goals/targets—while reducing runaway-costs associated with workplace injuries and illnesses.

PURPOSE

Early Incident Intervention provides TRC employees with **IMMEDIATE** telephonic access to WorkCare clinicians at the time of a presumed, non-emergency workplace injury or illness. Clinicians provide expert guidance on the evaluation of symptoms, appropriate first aid, and the need for additional medical evaluation or treatment.

When utilizing this service within the first hour of an incident, known as the “Golden Hour,” licensed medical staff can guide the case so that medical evaluation and treatment are rendered appropriately.

*“...helps the worker
traverse the unpredictable
terrain of work-related
injuries and illness.”*

PRINCIPLES OF EARLY INCIDENT INTERVENTION

- Utilizes principles of the “Golden Hour.”
- Provides workers immediate clinician support at the time of an incident.
- Focuses on providing the right care, at the right time in the proper setting.

BENEFITS FOR EMPLOYEES

- Instant access to a medically qualified professional for evaluation of symptoms and possible outcomes.
- Professional guidance on appropriate first aid measures and medications.
- Professional advice regarding the need for additional medical evaluation or treatment.

BENEFITS FOR TRC

- Point of contact for emergency and non-emergency medical clinicians.
- Triage the incident to determine risk and urgency, delivering interventions that are consistent with medical guidelines for the specified injury and illness.
- Maintains communication with clinicians to ensure accurate and timely reporting.

Attachment E
Job-Safety Analyses (JSA)

COMPANY/ PROJECT NAME or ID/ LOCATION (City, State) TRC 8802 5TH AVENUE AND 429 89TH STREET BROOKLYN, NY		DATE PREPARED FOR HASP: 04/06/2021		<input type="checkbox"/> NEW <input checked="" type="checkbox"/> REVISED	
JSA WORK ACTIVITY (Description): Soil Borings/ Well Installations		List of Contractor(s) and key work activity:			
SITE SPECIFIC JSA AUTHOR		POSITION / TITLE		DEPT	
Amber Bartlett		Environmental Scientist		ECR	
TRC HEALTH AND SAFETY MANAGEMENT		POSITION / TITLE		APPROVAL DATE	
Lindsay O' Hara		Senior Project Manager			
PERSONAL PROTECTION EQUIPMENT (PPE) QUICK SUMMARY Required PPE (indicate with "R") vs. Must Have Available On-site (indicate "A")					
R REFLECTIVE VEST R HARD HAT R GLOVES: ANSI Cut Level 4&5 Kevlar R SAFETY GLASSES R GOGGLES FACE SHIELD		R HEARING PROTECTION R SAFETY SHOES: <u>Protective Toe</u> 5pt. HARNESS / LANYARD PPE CLOTHING: Coveralls Tyvek Suit Nomex Other (specify):		RESPIRATORY PROTECTION: <input type="checkbox"/> NA 1/2 face Air Purifying Respirator (APR) Particulate Mask: <input type="checkbox"/> PM100 <input type="checkbox"/> PM95 Cartridge: <input type="checkbox"/> P100-Multigas <input type="checkbox"/> Full face ARP; specify cartridge type: Air Supplied Respirator SCBA Air-line	
Additional PPE: As per defined in the job/site specific Health and Safety Plan (HASP) wear PPE at all times when performing site work.					
Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.					
1 JOB TASKS		2 POTENTIAL HAZARDS		3 HAZARD CONTROLS (beyond wearing "Required" PPE)	
1) Set-up		a. Lack of concentration or focus. b. Fire and explosion. c. Electric shock/ electrocution. d. Malfunctioning heavy equipment safety devices.		a1. Review all plans (HASP, Work, Utility, Site Plans, etc.), logs, and field notes prior to starting a new task. Identify daily tasks and required personnel actions. a2. Conduct safety tailgate meeting with subcontractor personnel prior to beginning work activities. Explain the site safety hazards and work precautions outlined in the HASP and obtain signatures indicating the HASP was discussed. b1. No smoking or open flame. Periodically monitor ambient air concentrations with PID/ LEL Meters. Shut down job and move personnel and equipment upwind if hydrocarbon concentrations are HASP defined action levels. b2. Deploy 2-20lb ABC Fire extinguishers in accordance site safety officer's direction. c1. Have a qualified electrician cut all power connections to the site and remove main breaker from power panel. c2. De-energize all circuits/power sources and follow TRC's Lock-Out, Tag-Out (LOTO) procedures for circuits within 3-feet of boring location or 10-feet' of overhead utilities. d1. Inspect drill rig to determine if in good condition. Perform all equipment and safety checks prior to event startup (per operating manual).	

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.		
¹ JOB TASKS	² POTENTIAL HAZARDS	³ HAZARD CONTROLS (beyond wearing "Required" PPE)
1 cont.)	<p>e. Being struck by moving vehicles or equipment onsite.</p> <p>f. Bad organization creating confusion and hazard.</p> <p>g. Unauthorized personnel in exclusion zone.</p>	<p>e1. Always wear safety vest, establish eye contact with operators utilizing flag men wear appropriate.</p> <p>e2. Vehicles shall use reverse beepers or flagmen.</p> <p>e3. Create an exclusion zone at least 10-feet beyond the limits of the boring to limit access to staging/work area using snow fencing, barricades, delineators, cones and/or caution tape.</p> <p>e4. Face the direction of oncoming traffic during work activities when possible.</p> <p>f1. Identify staging area with good lateral and vertical access for loading and unloading of trucks.</p> <p>g1. Use visitor check-in log and allow no-one in exclusion area without proper PPE (as defined on this SA) and training documentation (e.g., HAZWOPER, other as defined in the HASP).</p>
2) Drilling	<p>a. Contact with subsurface water, gas, electrical, and/or fiber optic lines in the vicinity of drilling locations.</p> <p>b. Broken rod.</p> <p>c. Distracted driller.</p> <p>d. Slips, trips, and falls.</p> <p>e. Soil cross contamination.</p> <p>f. Cut/pinched fingers or toes; and strained muscles.</p> <p>g. Noise.</p> <p>h. Flying particles, dust and hazardous substances from clearance activities</p>	<p>a1. If unknown lines or obstructions are encountered, stop drilling and notify PM. Do not undermine any utilities.</p> <p>b1. Do not stand in close proximity of the rods being pushed into the ground. Stand off to the side and wear required PPE.</p> <p>c1. Always communicate with the driller before approaching the operating drill stem.</p> <p>d1. Spread absorbent to soak up any pools of water that accumulate during drilling.</p> <p>d2. Maintain a clean, unobstructed work area by good housekeeping and placing unused equipment away from work area.</p> <p>e1. Ensure downhole sampling equipment is cleaned between samples.</p> <p>e2. Create a clean sample collection area with removable poly sheeting/ aluminum foil or other method ensure a clean work surface that is refreshed between each sample.</p> <p>f1. See PPE Quick Summary.</p> <p>f2. Use proper lifting techniques and 2-man rule as outlined in TRC's Employee IIPP Handbook and "Back Safety A User's Guide" training module" handbook, when moving heavy objects (>50 lbs).</p> <p>g1. All personnel will use hearing protection within work area while heavy machinery is operating at >85 dB.</p> <p>h1. See PPE Quick Summary.</p>

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.		
¹ JOB TASKS	² POTENTIAL HAZARDS	³ HAZARD CONTROLS (beyond wearing "Required" PPE)
2 cont.)	<ul style="list-style-type: none"> i. Exposure to impacted soil or groundwater. j. Toxic or explosive atmosphere. k. Opening/handling core sleeves. l. Inclement weather/lightning. m. Heat illness. n. Cold illness. 	<ul style="list-style-type: none"> i1. Wear latex or nitrile gloves during handling of soil or ground water. j1. Periodically monitor ambient atmosphere with PID or LEL meter. Shut down job and move personnel and equipment upwind if concentrations are detected above HASP defined action levels. k1. Do not attempt to open retrieved core sleeves. Request the driller to open the plastic sleeves using ANSI cut level 5 Kevlar gloves. TRC personnel must have ANSI cut level 4 Kevlar gloves when handling/transporting open core sleeves. l1. Monitor forecasted weather prior to and during drilling activities. Hault drilling activities if lightning is observed or anticipated and wait in personal/company vehicle until weather passes or until directed otherwise by the project manager. m1. Refer to Activity Performed in Hot Illness Prevention SA. n1. Refer to Activity Performed in Cold Illness Prevention SA.
3) Boring Completion	<ul style="list-style-type: none"> a. Bad organization causing cross-contamination of soil, groundwater, or personnel. b. Moving heavy objects (>50-lbs) and mixing grout/concrete. c. Opening/closing/moving drums. d. Slips, trips, falls and physical injury during auger removal. e. Overspray and cross-contamination during rod decontamination. 	<ul style="list-style-type: none"> a1. Waste management—Identify and delineate soil stockpile area or storage area if soil cuttings/purge water are to be drummed. a2. Blot up puddles of standing water and the work area will be swept. b1. Get assistance for moving heavy objects and mixing grout/concrete. Use mechanical aids to move objects or mix grout/concrete. c1. Wear must wear ANSI cut rated 4 or 5 Kevlar gloves during the opening and closing of drums to protect fingers. c2. Use only drum dolly to move drums with soil, hydrated bentonite grout, or concrete or other heavy contents. c3. Empty metal drums could also cause strain or injury if not moved properly. Use caution and appropriate tools (e.g., dolly). d1. Place all removed rods to side, so as not to become a trip hazard. e1. See PPE Quick Summary. e2. Do not overspray while cleaning rods. Create a "clean zone" with plastic liner for placement of decontaminated rods.

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3)		
¹ JOB TASKS	² POTENTIAL HAZARDS	³ HAZARD CONTROLS (beyond wearing "Required" PPE)
LOCATION(S) WHERE HAZARD IS TO BE EXPECTED		³ HAZARD CONTROLS (beyond wearing "Required" PPE)
1.	a.	a.
2.	a.	a.
3.	a.	a.

Field Notes:

LIMITATION: As part of TRC's HSMS, a JSA is provided by TRC for its employees. The purpose of a JSA is NOT to identify all hazards associated with a task, but to identify key potential hazards to get TRC and other onsite personnel thinking about other potential safety hazards and mitigating actions for unsafe conditions and behavior during various works. TRC recognizes that JSA's may not cover every conceivable step or hazard that emerges during a job, so we've provided a "Field Change" section below to amend a JSA if required. The JSA does not supersede or replace any local, state or federal permit, regulation, statute or other entities policies and procedures but is simply a tool for enhancing the execution of safe work at a jobsite under TRC's supervision. Similarly, all subcontractors are required to provide their own JSA(s) for their specialty prior to performing any work for TRC or its customers in accordance with TRC's HSMS; however, any unsafe condition or hazard not covered in any JSA is ultimately the direct responsibility of the person or entity performing the work.

COMPANY/ PROJECT NAME or ID/ LOCATION (City, State) TRC 8802 5TH AVENUE AND 429 89TH STREET BROOKLYN, NY		DATE PREPARED FOR HASP: 04/06/2021		<input type="checkbox"/> NEW <input checked="" type="checkbox"/> REVISED	
JSA WORK ACTIVITY (Description): Groundwater Sampling and Gauging		List of Contractor(s) and key work activity: N/A			
SITE SPECIFIC JSA AUTHOR		POSITION / TITLE		DEPT	
Amber Bartlett		Environmental Scientist		ECR	
TRC HEALTH AND SAFETY MANAGEMENT		POSITION / TITLE		APPROVAL DATE	
Lindsay O' Hara		Senior Project Manager			
PERSONAL PROTECTION EQUIPMENT (PPE) QUICK SUMMARY					
Required PPE (indicate with "R") vs. Must Have Available On-site (indicate "A")					
___ R REFLECTIVE VEST ___ R HARD HAT ___ R GLOVES: ANSI Cut Level ___ Kevlar ___ R SAFETY GLASSES ___ GOGGLES ___ FACE SHIELD		___ HEARING PROTECTION ___ R SAFETY SHOES: <u>Protective Toe</u> ___ 5pt. HARNESS / LANYARD PPE CLOTHING: ___ Coveralls ___ Tyvek Suit ___ Nomex ___ Other (specify):		RESPIRATORY PROTECTION: <input type="checkbox"/> NA ___ 1/2 face Air Purifying Respirator (APR) ___ Particulate Mask: <input type="checkbox"/> PM100 <input type="checkbox"/> PM95 ___ Cartridge: <input type="checkbox"/> P100-Multigas <input type="checkbox"/> ___ Full face ARP; specify cartridge type: ___ Air Supplied Respirator ___ SCBA ___ Air-line	
Additional PPE:					
Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.					
1 JOB TASKS		2 POTENTIAL HAZARDS		3 HAZARD CONTROLS (beyond wearing "Required" PPE)	
1) Groundwater Measurements		a. Lack of concentration and unfamiliarity with site b. Moving vehicles. c. Pinched fingers or toes; and strained muscles. d. Lost equipment and damage to well from foreign objects. e. Fire/Explosions f. Electrocution g. Contamination h. Slip/trips and falls i. Noise j. Visitors/spectators		a. Review all plans and logs in field notebook prior to starting a new task. a. Follow cell phone use procedures when working. b. Always face traffic or moving equipment when working (establish eye contact with drivers). b. Follow work area exclusion Zone Procedures Use "buddy system" when unable to observe traffic of moving equipment (> 50 lbs). c. Wear leather gloves when opening barrels & well lids, lifting sharp or heavy equipment. Use proper tools for opening and closing purge water storage barrels. c. Lift heavy objects utilizing leg muscles rather than depending entirely on your back. Get assistance when equipment exceeds 50-lbs. d. Fasten equipment raising and lowering ropes or cables to object larger than well diameter. Carry no loose pens or tools in pockets, place well lid fasteners away from well opening. e. No Smoking or Open Flames while on site. Request anyone smoking to please extinguish cigarettes. Identify location(s) of all emergency shut-off devices. f. Perform all necessary equipment and safety checks prior to event startup (per operating manual). Check sounding and measurement equipment for shorts, frayed wires, or loose connections. g. Wear nitrile or latex gloves with handling water or soil. Wear Safety glasses with splash guards when handling groundwater. g. Always cap open wells and replace surface covers when finished. Don't leave any open well unattended. h. Maintain good house keeping - place unused equipment out walkways and work areas. Clean-up all spills. h. Use portable steps to mount and dismount sampling vehicle. Place equipment and tools down on truck bed before mounting and dismounting sampling vehicle. i. Use hearing protection when working with operating equipment (>75db). j. Control entry in work area using exclusions zones and check-in log in field notebook.	


Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3) throughout the day. Focus on each new task, procedures, and skill sets to be used.		
¹ JOB TASKS	² POTENTIAL HAZARDS	³ HAZARD CONTROLS (beyond wearing "Required" PPE)
2) Sample Storage and Well Closure	<ul style="list-style-type: none"> a. Damage to Samples b. Well Damage 	<ul style="list-style-type: none"> a. Use procedures outlined in TRC's Groundwater Monitoring and Sampling Procedures. b. Cap and lock sampled well, then securely fasten drive-over cover before moving onto next well to be sampled.
3)		

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3)		
¹ JOB TASKS	² POTENTIAL HAZARDS	³ HAZARD CONTROLS (beyond wearing "Required" PPE)
4)		
LOCATION(S) WHERE HAZARD IS TO BE EXPECTED		³ HAZARD CONTROLS (beyond wearing "Required" PPE)
1.	a.	a.
2.	a.	a.
3.	a.	a.

Field Notes:

LIMITATION: As part of TRC's HSMS, a JSA is provided by TRC for its employees. The purpose of a JSA is NOT to identify all hazards associated with a task, but to identify key potential hazards to get TRC and other onsite personnel thinking about other potential safety hazards and mitigating actions for unsafe conditions and behavior during various works. TRC recognizes that JSA's may not cover every conceivable step or hazard that emerges during a job, so we've provided a "Field Change" section below to amend a JSA if required. The JSA does not supersede or replace any local, state or federal permit, regulation, statute or other entities policies and procedures but is simply a tool for enhancing the execution of safe work at a jobsite under TRC's supervision. Similarly, all subcontractors are required to provide their own JSA(s) for their specialty prior to performing any work for TRC or its customers in accordance with TRC's HSMS; however, any unsafe condition or hazard not covered in any JSA is ultimately the direct responsibility of the person or entity performing the work.

Attachment F
Daily Pre-Job Safety Briefing Form

	TRC HEALTH AND SAFETY MANAGEMENT SYSTEM		<div>EHS Policy</div> <div>Management System Procedures</div> <div>Compliance Programs</div> <div>Forms, Checklists, Permits, etc.</div>
	DOCUMENT TITLE: COVID-19 Questionnaire for Onsite Workers		
	DOCUMENT NUMBER: CP052.2	Revision Number: 2	
	APPROVED BY: Mike Glenn	Page 1 of 1	

The safety of our employees and their families, subcontractors, clients, and visitors is TRC's highest priority. As the COVID-19 pandemic continues to evolve and spread, TRC will continue to monitor the CDC, WHO, and local agencies in order to provide up-to-date information to protect all of those in our community.

To prevent the spread of COVID-19 and reduce the potential risk of exposure to our employees, subcontractors, and visitors, we request all personnel involved with on-site project-related work complete this assessment questionnaire. This questionnaire will be completed upon arrival to the jobsite and prior to conducting any job-related tasks. Your participation is important to help us take precautionary measures to protect you and everyone on our team.

Date: _____

Name: _____

Company/Organization: _____

Email Address: _____

Phone Number: _____

Project Name: _____

- Do you have signs of a fever or measured temperature above 100.4°F or greater, a dry cough, tiredness, or trouble breathing within the past 24 hours?
☐ Yes ☐ No
- Have you had "close contact" with an individual diagnosed with COVID-19? "Close contact" means living in the same household as a person who has tested positive for COVID-19, caring for a person who has tested positive for COVID-19, being within 6 feet of a person who has tested positive for COVID-19 for 15 minutes or more, or coming in direct contact with secretions (for example, sharing utensils or being coughed on) from a person who has tested positive for COVID-19 while the person was symptomatic.
☐ Yes ☐ No
- Have you, or anyone inside your residence been exposed to someone else who is currently being quarantined by a doctor or a local public health official?
☐ Yes ☐ No

Be aware that your client may have additional requirements as well. Please consult the [COVID-19 Client Documents](#) on TRCNet to review your client's guidance. Only personnel who answer "No" to all questions listed above will be granted site access. **Copies of completed questionnaires are to be maintained onsite with the HASP and project documents. If the answer is "Yes" to question 1, please contact your Supervisor, Office Practice Leader/OPL, Mike Glenn, and your HR Business Partner.**



Daily Pre-Job Safety Briefing

Project Name: Orchard Street Site Project Number: 350304.0000.0000
Work Location: 42-24 Orchard Street, Queens, New York 11101 Date: _____
Tasks Performed: Remedial Investigation Time: _____ AM PM
Client Name: BLDG Submitted By: _____

Health and Safety Plan Available Onsite: Yes ☒ No ☐ Health and Safety Plan Location: _____
Emergency Facility(s): Mount Sinai Queens Emergency Room Number(s): (718) 932-1000
Physical Address: 3019 Crescent Street at, 30th Rd, 11102
First Aid/CPR Persons: _____

For Emergencies Dial 911/For Non-Emergencies Dial WorkCare (888) 449-7787

Personal Protective Equipment Required			Procedures/Programs Required	Yes	No	Additional Considerations	
	Yes	No	Type				
Fall Protection	<input type="checkbox"/>	<input type="checkbox"/>	_____	Hot Work	<input type="checkbox"/>	<input type="checkbox"/>	Work Procedures: <input type="checkbox"/> Isolation of equipment
body harness, lifelines, barricades, other (specify)				LOTO/Energy Control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Check for potential <input type="checkbox"/> Adequate grounding
Eye/Face	<input type="checkbox"/>	<input type="checkbox"/>	_____	Trenching/Excavation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Vehicle grounds <input type="checkbox"/> Working clearances
goggles, face shield, hood, other (specify)				Signs/Barricades	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Dig Safe/CBYD <input type="checkbox"/> E-911 Protocol
Respirator	<input type="checkbox"/>	<input type="checkbox"/>	_____	Confined Space	<input type="checkbox"/>	<input type="checkbox"/>	People: <input type="checkbox"/> Worker fatigue <input type="checkbox"/> Other work groups
SCBA, supplied air, HEPA, dust, other (specify)				Cranes/Critical Lifts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Public safety <input type="checkbox"/> Pedestrian control <input type="checkbox"/> Experience
Foot Protection	<input type="checkbox"/>	<input type="checkbox"/>	_____	Line Breaking/Hot Tap	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Traffic control <input type="checkbox"/> Other utilities <input type="checkbox"/> Spec. Training
safety toe, EH rated, rubber boots, other (specify)				Scaffolds/Aerial Lifts	<input type="checkbox"/>	<input type="checkbox"/>	Tools/Equipment: <input type="checkbox"/> Adequate cover-up
Hand Protection	<input type="checkbox"/>	<input type="checkbox"/>	_____	System Testing/ Grounding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Live line tools <input type="checkbox"/> Portable Grounds
leather, cut resistant, chemical, EH, other (specify)				Employee Certification/Training Required			<input type="checkbox"/> Inspection of tools/equipment
Head Protection	<input type="checkbox"/>	<input type="checkbox"/>	_____	Crane Operator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Specialized tools/equipment
hard hat, helmet, electrical hazard, other (specify)				Forklift Operator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Correct tool/equipment for the job
Clothing	<input type="checkbox"/>	<input type="checkbox"/>	_____	Mobile Equipment Operator	<input type="checkbox"/>	<input type="checkbox"/>	Special Precautions: <input type="checkbox"/> Adjacent structures
coveralls, welding, sleeves, rain, FR, reflective vest,				Competent Person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Condition of structures <input type="checkbox"/> Weather conditions
chemical, other (specify)				OSHA 10/30	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Lighting conditions <input type="checkbox"/> Terrain <input type="checkbox"/> Water bodies
Hearing Protection	<input type="checkbox"/>	<input type="checkbox"/>	_____	HAZWOPER	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> Spills and leaks <input type="checkbox"/> Environmental <input type="checkbox"/> Cultural
				Clearance/Tagging Authority	<input type="checkbox"/>	<input type="checkbox"/>	Other: _____

If Conditions CHANGE...Stop Work, Review and Revise the Plan!!

Daily Pre-Job Safety Briefing

Hazards Associated with the Job (focus on the GEMS)				
Gravity	Electrical	Mechanical	Kinetic	Other/Environmental
<input type="checkbox"/> Falling from a height <input type="checkbox"/> Falling objects <input type="checkbox"/> Falling structures <input type="checkbox"/> Climbing obstructions <input type="checkbox"/> Dangerous trees <input type="checkbox"/> Aerial device operation	<input type="checkbox"/> Electrical contact <input type="checkbox"/> Induced voltage <input type="checkbox"/> Back-feed <input type="checkbox"/> Flash potential <input type="checkbox"/> Step/Touch potential <input type="checkbox"/> Static charge	<input type="checkbox"/> Equipment failure <input type="checkbox"/> Conductor tension <input type="checkbox"/> Cable tension <input type="checkbox"/> Loaded springs <input type="checkbox"/> Moving parts <input type="checkbox"/> Crane/Rigging	<input type="checkbox"/> Traffic <input type="checkbox"/> Driving conditions <input type="checkbox"/> Moving/Shifting loads <input type="checkbox"/> Rotating machinery <input type="checkbox"/> Vehicle stability <input type="checkbox"/> Heavy equip. operation	<input type="checkbox"/> Asbestos/Lead <input type="checkbox"/> Animals/Insects <input type="checkbox"/> Confined space <input type="checkbox"/> Excavations <input type="checkbox"/> Heat/Cold <input type="checkbox"/> Pressurized fluids/gases
List all hazards associated with this task		Signature of Crew Members Present		<h2>Post Task Safety Analysis</h2>
				Did any injuries or incidents occur today? If yes, explain.
				<input type="checkbox"/> Yes <input type="checkbox"/> No
Barriers to eliminate/control above hazards?				Was the injury or incident reported the safety department?
				<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
				What problems did you have with today's work assignment?
				What can we do tomorrow to improve performance?
Supervisor Signature				

Attachment G
Incident Reporting Forms

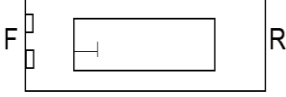


AUTO INCIDENT REPORT

TRC DRIVER INFORMATION:

Driver's Name: _____ Driver's Phone: () _____
Company Name: _____ Company Location: _____
Supervisor's Name: _____ Supervisors Phone: () _____
Project Name: _____ Client Name: _____
Driver's Date of Birth (MM/DD/YY): _____ Driver's License #: _____ State: _____

TRC VEHICLE INFORMATION (V-1):

Year/Make/Model of Vehicle: _____
License Plate #: _____ Vehicle ID # (VIN): _____
Circle Point of Contact:  Was Vehicle Drivable? ☐ Yes ☐ No
Personal: ☐ Yes Rental: ☐ Yes Fleet: ☐ Yes
Rental Company _____

INCIDENT INFORMATION:

Date of Incident: _____ Time of Incident: _____ A.M. _____ P.M. Photos Taken: ☐ Yes ☐ No
Location of Incident: _____ City: _____
Were The Authorities Contacted? Police: ☐ Yes ☐ No Ambulance: ☐ Yes ☐ No Fire: ☐ Yes ☐ No
Name of Police Dept: _____ Case #: _____ Officer Name: _____
Were Citations Issued? ☐ Yes ☐ No If Yes, To Whom? _____
Citation Number: _____
Were There Any Witnesses? ☐ Yes ☐ No If Yes, Please Provide Name, Address and Phone Below:
Witness Name: _____ Witness Phone: () _____
Witness Address: _____
Traffic Conditions (i.e., heavy, light): _____ Weather Conditions (i.e., dry, wet, ice, fog): _____
Was the TRC Driver Injured? ☐ Yes ☐ No Was Medical Treatment Received? ☐ Yes ☐ No
Describe Injuries: _____

Describe Damage to Property Other Than Motor Vehicles (i.e., guardrails, mailboxes, etc.): _____

AUTO INCIDENT REPORT

OTHER DRIVER & VEHICLE INFORMATION (V-2):

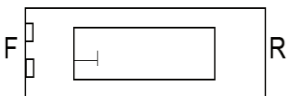
Driver's Name: _____ Driver's Phone: () _____

Driver's Address: _____

Owner's Name (If different than driver): _____ Owner's Phone: () _____

Owner's Address: _____

Year/Make/Model of Vehicle: _____ License Plate #: _____ State: _____

Circle Point of Contact: 

Was Vehicle Drivable? ☐ Yes ☐ No

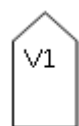
Insurance Company Name: _____ Policy Number: _____

Insurance Company Phone: () _____ Number of Passengers in Vehicle: _____

List Persons Injured: _____

Were Any Other Vehicles Involved in Incident? ☐ Yes ☐ No If yes, provide details below: _____

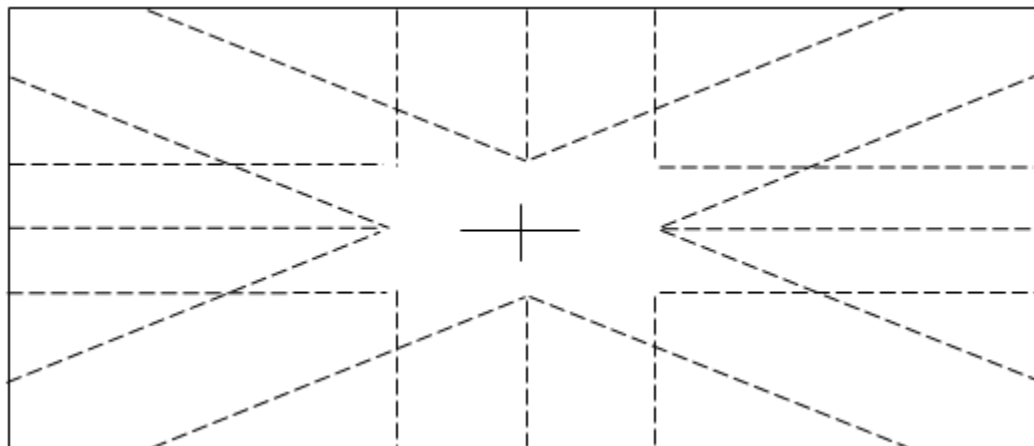
PLEASE DESCRIBE THE INCIDENT AND COMPLETE THE DIAGRAM BELOW. Be sure to indicate as many details as possible (i.e., How many lanes in each direction; Were there any turn lanes; What kind of traffic controls were there – light, stop sign, yield sign, Positions of vehicles on impact).



V-1 TRC Vehicle



V-2 Other Vehicle



Completed By: _____ Signature: _____



TRC Incident Report Form

(To be completed immediately after an Injury, Illness, Incident, Accident or Significant Near Miss by Employee’s Supervisor and Employee involved)

Incident Category		
<input type="checkbox"/> Employee Injury/Illness <input type="checkbox"/> Near Miss/Loss <input type="checkbox"/> Property Damage <input type="checkbox"/> Vehicle Accident <input type="checkbox"/> Fire <input type="checkbox"/> Other: Specify		
1	Incident Location:	
2	Site Identification/Project No.:	
3	Site Address:	
4	Date Incident Occurred:	
5	Time Incident Occurred:	
6	Date Incident Reported to Supervisor:	
7	Date Report Completed:	
8	Was WorkCare Contacted? <input type="checkbox"/> Yes <input type="checkbox"/> No	
9	Client:	

TRC Employee Information		
10	Name:	
11	Address:	
12	Employee Phone:	
13	Title or Occupation:	
14	Sector/Practice:	
15	Supervisor Name/Phone:	
TRC Employee Information (to be completed by Worker's Compensation Claims Administrator)		
16	Employee Date of Birth:	
17	Employee Social Security Number:	
18	Employee Marital Status:	<input type="checkbox"/> Married <input type="checkbox"/> Single
19	Number of Dependant under the age of 18:	
20	Date of Hire:	
21	Rate of Pay:	Hours per week:

Type of Employee Injury or Illness (To be determined by Safety Director)			
22	<input type="checkbox"/> First Aid Only	20	<input type="checkbox"/> Extended Time Away From Work (3 days or more)
23	<input type="checkbox"/> Medical Treatment Only	21	<input type="checkbox"/> Fatality
24	<input type="checkbox"/> Restricted Work-case	22	<input type="checkbox"/> Other (specify):
25	<input type="checkbox"/> Lost Workday		
26	Estimated Number of Days on Restricted Work:		
27	Estimated Number of Days Away from Work:		

Employee Injury or Illness Description	
28	Describe the Injury or Illness:
29	First Aid/Medical Treatment Administered:
30	Name of Doctor’s Office, Clinic, or Hospital: Concentra
31	Address and Phone Number:

Incident Description	
32	Equipment Involved:
33	Site Description:
34	What task was being performed at time of incident?
35	Describe Incident in Detail :
36	Conditions at time of Incident: (weather, lighting, etc.):
37	Motor Vehicle Accident:
38	TRC Vehicle ID:

39	Year/Make/Model:	
<input type="checkbox"/> DOT Regulated Vehicle <input type="checkbox"/> Towed From Scene <input type="checkbox"/> Airbag Deployed <input type="checkbox"/> Seatbelt in Use <input type="checkbox"/> TRC Fleet <input type="checkbox"/> Rental <input type="checkbox"/> Personal Vehicle		
40	Other Vehicle License Plate	
41	Other Vehicle Year/Make/Model	
42	Other Vehicle Driver Name	
43	Other Vehicle Year/Make/Model	
44	Other Injured Parties <input type="checkbox"/> Yes <input type="checkbox"/> No	
43	Description of other injuries:	

Supervisor’s Post-Incident Review and Recommendations	
<div>Safety Violation<div><input type="checkbox"/> Yes</div><div><input type="checkbox"/> No</div></div>	
58	State the company safety rule, OSHA regulation, or specific training that was violated:
59	Describe the training the employee received to prevent this violation:

#	Root Cause Factors (RCF)
1	Lack of skill or knowledge
2	In the past, did not follow procedures or acceptable practices and no incident occurred (injury, product quality incident, equipment damage, regulatory assessment or production delay)
3	Doing the job according to procedures or acceptable practices takes more time/effort
4	Short-cutting procedures or acceptable practices are positively reinforced or tolerated
5	Lack of or inadequate operational procedures
6	Inadequate communication of expectations regarding procedures or acceptable practices
7	Inadequate tools or equipment (available, operable and safely maintained, proper task and workplace design)
8	External factors

60	Root Cause(s)	Identified Root Cause(s):							
		#1	#2	#3	#4	#5	#6	#7	#8
A		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
G		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

61	Conclusion: Why did the Incident Occur?						
62	Item No.	RCF No.	Recommended Corrective Action(s) How to Prevent Incident from Reoccurring	Responsible Person	Due Date	Completed (date)	Verified/Validated (date)

Supervisor: _____ Signature: _____ Date: _____
TRC Safety Director: _____ Signature: _____ Date: _____



TRC Incident Reporting Guidelines

Incident Response:

1. For life threatening injuries and medical emergencies call 911 or go to the closest emergency room.
2. An injured worker must report an injury to their supervisor immediately.
3. Supervisor is required to complete The TRC Incident Report Form within 24 hours of the reported accident and forward to Bill Russell at Sargent & Associates with a copy to Mike Glenn.

Bill Russell – Sargent & Associates

Office: (978) 256-7459; Fax: (978) 256-4941
bill@sargentandassociates.com

Mike Glenn, National Safety Director

Office: (949) 727-7347; Mobile: (949) 697-7418
mglenn@trcsolutions.com

4. WorkCare can provide assistance in providing first aid advice and directing an injured worker to non-emergency medical care. WorkCare is a service that provides 24/7 access to an Occupational Healthcare physician or clinician.

WorkCare Incident Intervention
(888) 449-7787

Return to Work:

1. The injured worker is responsible for providing the Supervisor with a copy of the doctor's note detailing the injury and "return to work" status within 24 hours of the doctor's visit. The supervisor must email or fax the completed TRC Incident Report and Doctor's notes to Sargent & Associates.
2. Sargent & Associates will contact the injured worker and the Supervisor to confirm the facts surrounding the injury.
3. Sargent & Associates will report the injury to the workers' compensation insurance carrier, Zurich.



4. Zurich may contact the injured worker and supervisor to conduct an accident investigation.
5. Sargent & Associates will maintain communication with all parties in order to monitor the medical treatment, and the injured worker's return to work status. They will act as liaison between the injured worker, TRC, and Zurich.
6. Sargent & Associates will work with TRC's Health & Safety, Human Resources, and/or Supervisors to determine if modified duty work is an option, until the injured worker is able to return to full duty work activities.

Incident Investigation:

1. All incidents that result in injuries that require reporting for OSHA recordkeeping purposes and all high potential first aid and near miss events require an incident investigation.
2. The Supervisor with assistance from the National Safety Director and/or Safety Coordinator, must complete the incident investigation report/contributing cause analysis within 7 days of the incident and must develop a corrective action plan within 14 days of the incident.

Attachment H

Observation Forms

TRC SAFETY OBSERVATION FORM

Revised January 2014

Location/Project Name: _____		Date: _____	
Observer Name: _____			
Observee Name: _____		Time: _____	
Task Observed			
Description of Task Observed and Background Information			
Positive Comments			
Conclusions / Why the Questionable Items Occurred?			
Feedback Session Conducted By: _____		Date: _____	
Name of Observee's Supervisor: _____		Time: _____	
At-Risk Observations/Root Cause Analysis			
<u>Personal Factor:</u> (1) Lack of skill or knowledge (2) Correct way takes more time/requires more effort (3) Shortcutting standard procedures is rewarded or appreciated (4) In past, did not follow procedures or acceptable practices and no incident occurred		<u>Job Factor:</u> (5) Lack of or inadequate operational procedures or work standards (6) Inadequate communication of expectations or work standards (7) Inadequate tools or equipment	
At-Risk Observation #	Root Cause Analysis #	Solution(s) To Prevent Potential Incident from Occurring	Person Responsible
Agreed Due Date	Date Completed		
Results of Verification (were solutions done?) and Validation (were solutions effective?)			
Reviewed by (PM/Supervisor): _____		Date: _____	
Approved by (Practice Safety Leader): _____		Date: _____	

TRC SAFETY OBSERVATION FORM

Revised January 2014

PERSONAL PROTECTIVE EQUIPMENT	Safe	At-Risk	Comments
1. Hearing Protection (e.g., Ear Plugs)			
2. Head Protection (e.g., Hard Hat)			
3. ANSI Rated Eye Protection (e.g., Safety Glasses)			
4. Hand Protection (e.g., Kevlar Gloves)			
5. Foot Protection (e.g., Safety Shoes)			
6. Respiratory Protection			
7. Fall Protection Inspected (e.g., Harness)			
8. ANSI Rated Reflective Vest/High Visibility Clothing			
9. Other (Specify)			
BODY USE AND POSITIONING	Safe	At-Risk	Comments
10. Correct Body Use and Positioning When Lifting/Pushing/Pulling			
11. Pinch Points/Moving Equipment - Hands/Body Clear			
12. Mounts/Dismounts Using 3-Points of Contact			
13. Other (Specify)			
WORK ENVIRONMENT	Safe	At-Risk	Comments
14. Work/Walk Surface Free of Obstructions (e.g., Tripping Hazards)			
15. Housekeeping/Storage			
16. Defined and Secured (e.g., warning devices, barricades, cones, flags)			
17. Suspended Load, Swing Radius & Lift Area is Barricaded			
18. Safety Shutdown Devices			
19. Proper Storage & Labeling /Disposal of Sample & Waste Materials			
20. Cylinders Stored Upright, Secured, & Caps in Place			
21. Manhole/vault Inspected for Hazards			
22. Other (Specify)			
OPERATING PROCEDURES	Safe	At-Risk	Comments
23. Job Planning (HASP reviewed, JSAs, etc.)			
24. Fire Extinguishers Accessible and Inspections Current			
25. Work Permit/Authorization to Work (Hot, Cold, LOTO, Confined Space)			
26. JSA Reviewed & Followed			
27. Hazard Assessment - Hazard Hunt			
28. Interfaces with Other Functions (awareness with other personnel on site)			
29. Operators Looking Behind Prior to Backing Up			
30. Operators Wearing Seat Belts While Operating Equipment			
31. Subsurface Structures Identified			
32. Proper Trench Protective Equipment in Place			
33. Adequate Egress Is Available for Excavation & Trench (within 25 ft. if depth is <4 ft.)			
34. All Materials Set Back at Least 2 Feet From Edge of Trench/Excavation			
35. Other (Specify)			
TOOLS/EQUIPMENT	Safe	At-Risk	Comments
36. Hand Tools (Proper Equipment Selection, Condition, and Use)			
37. Power Tools (Proper Equipment Selection, Condition, and Use)			
38. Equipment, Including Heavy (Proper Equipment Selection, Condition, and Use)			
39. Hoses Inspected			
40. Required Monitoring Equipment Calibrated & Used			
41. Ladders Set up Correctly & Inspected			
42. Right Tools for the Job are Available and in Good Condition - No Fixed Open Blade Knives (FOBKs)			
43. Other (Specify)			
Total #	0	0	

Attachment I
Safe Catch Form



"Safe Catch" Report

A "Safe Catch" is a potential hazard or incident that has not resulted in any personal injury. Unsafe working conditions, unsafe employee behaviors, improper use of equipment or use of malfunctioning equipment have the potential to cause work related injuries. It is everyone's responsibility to report and/or correct these potential incidents immediately. Please complete this form as a means to report these "Good Catch" situations and submit to your local OSC Representative and Mike Glenn, National Safety Director.

Employee Name:		Date:	
Incident Location:		Office:	
Project:		Practice:	
Conditions			
Please check all appropriate conditions:			
<input type="checkbox"/> Unsafe Act	<input type="checkbox"/> Unsafe Condition	<input type="checkbox"/> Unsafe Equipment	<input type="checkbox"/> Unsafe Use of Equipment
Description of Incident or Potential Hazard:			
Task Performed at Time of Incident:			
Causes (Primary and Contributing):			
Corrective Action(s) Taken (remove the hazard, replace, repair, or retrain):			
Employee Signature:		Date Completed:	

Our Mission: To reduce the frequency of incidents by applying local lessons learned globally.

If you have any questions about this report or would like additional information, please reference Compliance Program [CP019—TRC Incident Response and Lessons Learned Program](#), located on TRCNET or contact Mike Glenn, National Safety Director at mglenn@trcsolutions.com.

APPENDIX D
Key Personnel Qualifications

KEVIN BOGER, PE

PROPOSED PROFESSIONAL TITLES: Program Manager, Project Manager and Project Engineer

YEARS OF ENVIRONMENTAL CONSULTING EXPERIENCE: 13

EDUCATION

B.S., General Engineering, Gonzaga University, 2005

B.A., Business Administration, Gonzaga University, 2004

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS

Professional Engineer, New York

AREAS OF EXPERTISE

Mr. Kevin Boger is a New York State Licensed Professional Engineer based in TRC's New York City office, has over 13 years of environmental consulting experience, and has assumed progressively increasing responsibilities primarily in project management, design, technical review, budget and schedule performance, and construction oversight of remedial actions and soil vapor intrusion mitigation systems for the New York City School Construction Authority. Mr. Boger has experience in the following areas:

- Program and Project Management
- Remedial Design
- Remedial Construction Inspection
- Vapor Intrusion Mitigation System Design
- Remedial Construction Management
- Environmental Site Assessment
- Remedial Investigation
- Underground Storage Tank Testing, Removal, and Closure
- Indoor Air Quality Investigations

REFERENCES			
Name	Title	Address	Telephone No. & E-mail Address
Ms. Anna Ramirez	Industrial Hygienist - C	NYCSCA 30-30 Thomson Ave. Long Island City, NY 11101	(718) 472-8242 aramirez@nycsca.org
Mr. Srinivas Kanaparthi	Industrial Hygienist - C	NYCSCA 30-30 Thomson Ave. Long Island City, NY 11101	(718) 472-8620 skanaparthi@nycsca.org

REPRESENTATIVE EXPERIENCE (Descriptions marked with an asterisk (*) undertaken within past three years)**New York City School Construction Authority (NYCSCA)***

Under consecutive hazardous materials services contracts with the New York City School Construction Authority (NYCSCA), Mr. Boger has served as a project manager and project engineer, reporting directly to the program manager, for the design and/or inspection of construction of vapor intrusion mitigation systems for over forty (40) New York City public schools. Mr. Boger's responsibilities have included the design of sub-slab depressurization systems (SSDSs) and gas vapor barrier systems. Additionally, Mr. Boger's project management responsibilities have included technical review and management of budget and scheduling for these projects. Mr. Boger has also worked closely with NYCSCA IEH project managers to reconcile changes in schedules and budgets for projects and coordinated projects with other NYCSCA divisions.

Specific design tasks performed by Mr. Boger have included specification writing, drawing preparation, engineering calculations, coordination with architects and engineers, and direction of project staff in project scoping and design alternative assessment. In connection with construction, Mr. Boger's responsibilities have included submittal review and performing inspections at critical milestones including completion of construction of gas permeable aggregate layer, completion of construction of sub-slab depressurization pits and piping, pressure testing of piping, completion of construction of suction fans and instrumentation, completion of preparation of sub-grade for application of gas vapor barriers, and startup and testing of SSDSs. Mr. Boger has also been responsible for preparing inspection reports, identifying construction deficiencies, attending meetings with contractors, and performing sub-slab pressure field testing to verify performance of SSDSs.

Mr. Boger has served as project manager and project engineer for over fifty (50) petroleum bulk storage (PBS) closure and/or remediation projects. Specifically, Mr. Boger supervised and directed staff in preparation of drawings and specifications for removal or closure of aboveground and underground storage tanks, petroleum-contaminated soil, and hazardous waste, and completed technical review and quality control of specifications and drawings. Additionally, Mr. Boger has performed inspections during excavation of hazardous and petroleum-contaminated soil and storage tank removals. Mr. Boger has been responsible for review and processing of submittals, including Excavated Material Disposal Plans and Tank Closure Plans. For example, in connection with NYSDEC Spill No. 1103225, Mr. Boger specified tank cleaning and removal, monitoring well abandonment, and reviewed the submittals and oversaw the excavation of several hundred cubic yards of petroleum-contaminated soil at the site known as Beacon High School located on 44th Street in Manhattan, New York. This project involved remediation of fuel oil spills in an existing building in support of new school construction. Mr. Boger's responsibilities included site inspections, confirming compliance with the contract drawings and specifications, construction meeting attendance, and preparation of a spill closure report that included proof of installation of engineering controls into the school construction.

Mr. Boger has served as the project manager for dewatering design and permitting services

for three NYCSCA construction sites. Specific services have included development of conceptual dewatering plans to determine dewatering flow rates, specifying treatment systems for groundwater treatment, preparing applications for New York City Department of Environmental Protection (NYCDEP) and New York State Department of Environmental Conservation (NYSDEC) permits, as well as correspondence with regulatory agencies in connection with obtaining required approvals for dewatering.

Additionally, Mr. Boger created templates for NYCSCA use in evaluating proposed sources of backfill with respect to chemical quality criteria.

The Port Authority of NY & NJ: Bulk and Satellite Fuel Farms - JFK International Airport, Jamaica, New York*

Mr. Boger served as a project engineer for engineering and design services in support of upgrades of two dual phase extraction systems at JFK International Airport. Mr. Boger was responsible for specifying a custom oil water separator, pumps, piping, bag filters, a vacuum blower, air stripper, liquid vapor separator, and process instrumentation; preparation of an engineer's cost estimates; and preparation of bid documents.

NYCO Environmental and Dewatering Corp. - New York, NY*

Mr. Boger has served as the project manager for dewatering design and permitting services for several construction dewatering projects in New York City. Specific services have included development of conceptual dewatering plans to determine dewatering flow rates, specifying treatment systems for groundwater treatment, preparing applications for NYCDEP and NYSDEC permits, as well as correspondence with regulatory agencies in connection with obtaining required approvals for dewatering. For example, Mr. Boger was the lead engineer for design and permitting for a dewatering system installed at LaGuardia Airport in New York in support of airport redevelopment.

United States Postal Service - New Jersey

Mr. Boger served as the project engineer for the design and construction inspection phases of an SSDS for a new retail post office in New Jersey. Mr. Boger's responsibilities for design included specification writing, drawing preparation, engineering calculations and coordination with architects and engineers. Construction phase services included site visits to inspect the SSDS installation for conformance with the Contract Documents.

Jetco Facility - Hunts Point, Bronx, New York

Mr. Boger served as the project engineer for the design of a SSDS, vapor barrier system and indoor methane monitoring system for a 200,000 square-foot retail warehouse constructed on an historic landfill in the Bronx, New York. Mr. Boger's specific responsibilities included preparing drawings and specifications, selecting and specifying equipment for the methane monitoring and notification systems, and coordinating SSDS and methane monitoring design elements with architects and engineers for the project.

Exxon-Mobil Bayway Facility in Linden, New Jersey

Mr. Boger served as a project engineer in support of the design of the groundwater extraction system for the sludge lagoon operable unit (SLOU) at the Exxon-Mobil Bayway facility in

Linden, New Jersey. The purpose of the groundwater extraction system is to effect hydraulic control over the SLOU. Design of 21 dual phase extraction (groundwater and oil) wells, thousands of feet of buried piping, and complex controls and instrumentation was required. Specific tasks performed by Mr. Boger included selecting and specifying equipment, and design and preparation of drawings for sub-grade piping drainage and isolation pits.

Queens West Development – Stage 2 Site - Long Island City, Queens

Mr. Boger served as project engineer for the design of SSDSs for the new high-rise residential buildings constructed on the Queens West Development – Stage 2 Site in Long Island City, Queens (NYSDEC VCP Site Nos. V00505A and V00505B). The Queens West Development – Stage 2 Site is the site of a former oil refinery. Mr. Boger prepared the drawings and specifications and coordinated the SSDS designs with building foundation plans and coordinated locations for sub-slab depressurization pits and monitoring points with the architects and design engineers for the buildings. Mr. Boger was also responsible for inspection services during construction of the SSDSs and performed pressure field testing following start-up of the SSDSs to verify sub-slab depressurization.

New York City Department of Environmental Protection (NYCDEP) Chemical Bulk Storage (CBS) Projects

Mr. Boger served as project engineer on several NYCDEP chemical bulk storage (CBS) projects. Mr. Boger was responsible for construction inspection of chemical bulk storage facilities, utilized for the storage of chlorine and other chemicals related to the water treatment and distribution systems, operated by the NYCDEP throughout New York City. The chemical bulk storage facilities were inspected by Mr. Boger for compliance with NYSDEC CBS regulations.

New York State Hazardous Waste Reduction Plans, and Annual RCRA Reports – New York

Mr. Boger was responsible for preparing quarterly hazardous waste reports, New York State Hazardous Waste Reduction Plans, and annual RCRA reports for a semi-conductor manufacturing facility in New York. Mr. Boger also oversaw decommissioning of Solid Waste Management Units within the semi-conductor manufacturing facility. Specific tasks performed by Mr. Boger included overseeing coordination between several contractors, oversight of sampling activities and correspondence with the NYSDEC.

SPECIALIZED TRAINING

- OSHA 40-Hour Hazardous Waste and Emergency Response Training
- OSHA 8-Hour Hazardous Waste and Emergency Response Refresher Training
- OSHA 10-Hour Construction Safety Training
- MTA Long Island Rail Road Roadway Protection Training

SANJAY SHARMA, CPG

EDUCATION

M.S., Environmental & Waste Management, SUNY, Stony Brook, NY, USA, 2005

M.S., Material Science and Engineering, SUNY, Stony Brook, NY, USA, 2005

M.S., Mineral Exploration, Indian School of Mines, India, 1977

M.S., Geology, University of Jabalpur, India, 1976

B.S., Geology, University of Jabalpur, India, 1974

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS

- Certified Professional Geologist (AIPG – CPG # 10982)
- Professional Geologist (State of Alaska - P.G. License No. 565)

AREAS OF EXPERTISE

- Reviewed construction submittals;
- Performed site assessments utilizing Geoprobe, Air Rotary, Hollow-Stem Auger, and Mud Rotary, Sonic drilling techniques;
- Performed multimedia sampling including vapor intrusion assessments;
- Performed groundwater investigations including installation and development of monitoring wells;
- Performed quarterly groundwater and landfill gas sampling for various landfill sites;
- Performed environmental inspections, Phase II ESIs, UST closures, and emergency response;
- Scheduled and coordinated field activities; and
- Provided field training to new team members.

REPRESENTATIVE EXPERIENCE

Mr. Sharma is a Certified Professional Geologist (CPG) with the American Institute of Professional Geologists and a registered Professional Geologist (PG) in the state of Alaska. Mr. Sharma has more than 7 years of professional experience as a geologist in the environmental consulting field and more than two decades of diverse professional experience as an exploration geologist.

Mr. Sharma has been a “key team member” for several consecutive environmental consulting contracts with the New York School Construction Authority (NYCSCA) and the New York State Department of Environmental Conservation (NYSDEC). Mr. Sharma’s environmental consulting work has primarily focused on the assessment and remediation of contaminated soil, soil vapor, and groundwater. In addition, he has performed environmental inspection services at numerous construction sites. His responsibilities and work experience have also included: Phase I Environmental Site Assessments (Phase I ESAs); Phase II Environmental Site Investigations (ESIs); underground storage tank (UST) closures; multimedia environmental compliance; vapor intrusion assessments; low-flow groundwater sampling; implementation of remedial action work plans; sub slab depressurization system (SSDS) inspections; implementation of projects under the New York State Brownfield Cleanup Program; and remediation system installations and decommissioning. Mr. Sharma’s work has also included proposals, report writing, review of project submittals, health & safety coordination, employee training, and client and regulatory interaction.

Mr. Sharma is also an experienced exploration geologist with over 22 years of experience with the Department of Atomic Energy (DAE), India. In DAE his responsibilities ranged from conducting the exploratory drilling programs (Deepest boring with diamond core drilling of 1175 meters) for uranium exploration, radioactive waste management programs, geotechnical investigations for mine development, and environmental surveys.

RELEVANT EXPERIENCE

New York City School Construction Authority (SCA) Projects

- Performed oversight during ongoing remediation work at Brownfield Cleanup Program sites;
- Performed investigation and remediation oversight at a Manufacturing Gas Plant (MGP) site;
- Performed Phase II ESIs, tank closures, and emergency response at NYCSCA construction sites and active schools;
- Performed oversight of hydraulic lift closures;
- Performed inspection services during contaminated soil excavation and loading in accordance with Excavated Material Disposal Plans (EMDPs);

- Prepared and executed ORC injection Plan; Performed inspection services during SSDS installations;
- Implemented Community Air Monitoring Programs during remediation activities;
- Performed oversight during the installation of an air sparge and soil vapor extraction system at a chlorinated solvent contaminated site;
- Tabulation and correlation of laboratory data relative to New York State regulatory criteria and guidance values; and
- Performed groundwater permeability and step-draw down tests, groundwater flow direction calculations, and studies on groundwater tidal fluctuations by setting up “Level Troll 700” devices and utilizing “Win-Situ 5.4.2.5” software.

Class 2 Inactive Hazardous Waste Site- Bulova Corporation, Sag Harbor, NY:

Performed subsurface investigations including soil, groundwater, and vapor sampling for the delineation of subsurface chlorinated solvents at the site.

Voluntary Cleanup Program Site- Bulova Corporation, Jackson Heights, NY:

Performed remedial investigation to assess the extent of chlorinated impacts to soil, soil gas, and groundwater at the site. Investigations also included vapor intrusion studies at on-site and off-site buildings. Performed “Acid Treatment” of injection and extraction wells for a bio-stimulation injection/recirculation system.

The Port Authority of New York & New Jersey - JFK Airport

- Prepared Soil Management Plan;
- Performed multimedia sampling; and
- Performed inspection services during ongoing remediation work.

Consolidated Edison Company of New York, Inc. (Con Edison)

- Prepared site specific Health & Safety Plans and project specifications;
- Performed UST investigations;
- Performed assessment of ongoing remediation systems, plume delineations, and performed groundwater investigations by installation and developing the monitoring wells;
- Synthesized, tabulated and interpreted laboratory data obtained from the groundwater sampling at 17 sites in New York City and Westchester County; and

- Writing of quarterly groundwater monitoring and gauging reports for submission to the NYSDEC.

SPECIALIZED TRAINING

- OSHA 8 Hour HAZWOPER Refresher, 2012
- OSHA 10 Hour Construction Safety and Health, 2012
- Confined Space Supervisor Training, 2007
- OSHA 8-Hour HAZWOPER Supervisor Training, 2006
- OSHA 40-Hour HAZWOPER Training, 2005

PROFESSIONAL AFFILIATIONS

- Geological Society of London - Fellow
- Geological Society of India - Life Fellow
- Geological Society of America - Member

ELIZABETH A. DENLY

EDUCATION

B.A., Chemistry, University of New Hampshire, 1987

PROFESSIONAL REGISTRATIONS /CERTIFICATIONS

Licensed Site Professional Association, Massachusetts, Associate Member

American Chemical Society (ACS)

American Society for Quality (ASQ)

AREAS OF EXPERTISE

Ms. Denly has 28 years of experience in:

- Quality Assurance/Quality Control
- Data Validation
- Laboratory Audits
- Gas Chromatography: Field and Laboratory Analyses
- Gas Chromatography/Mass Spectrometry: Field and Laboratory Analyses

Quality Assurance/Quality Control

As a QA chemist at TRC, Ms. Denly is responsible for providing QA/QC oversight in support of a variety of environmental investigations including contaminant ambient air monitoring, human health and ecological risk assessments, riskbased soil cleanups, remediation programs, and delineation. Ms. Denly has provided this oversight under different regulatory programs, including MassDEP, NYSDEC, NJDEP, and USEPA Region I, Region II, Region III, and Region V. In this role, she has been responsible for the preparation of the project-specific QAPP, coordination with the laboratory, selection of the appropriate analytical methodologies to achieve the desired state or regulatory standards, oversight and performance of the data validation process, and determination of the usability of the data in comparison to the overall project objectives.

In addition, Ms. Denly serves as TRC's Remediation and Building Science Practices Quality Assurance & Chemistry Systems Manager, responsible for the creation and implementation of the Sector's Quality Management Plan and Standard Operating Procedures (SOPs) for field sampling and documentation protocols. Ms. Denly also leads Quality Coordinator networks in the Remediation and Building Science Practices which are responsible for the development and communication of quality initiatives within the organization. Among the quality initiatives that have been implemented or created under Ms. Denly's leadership include the following:

- Procedures for Peer Review of Deliverables

- Tracking of Peer Review Documentation via monthly random audits
- Project Planning Checklist tool
- Analytical Data Review Checklist and Training
- Practice Self-Assessments with follow-up Corrective Actions
- Biweekly Quality Messaging
- Technical Editing Guidelines
- Publication of Quality Lessons Learned reports

Data Validation

Ms. Denly provides oversight and senior review on data validation performed for a variety of analytical parameters. She performs data validation for organic parameters including VOCs, SVOCs, Pesticides, PCB Aroclors, PCB homologues/congeners, Dioxins, specialty analyses including GC/MS/SIM and various air analyses. Validation and reporting guidelines utilized include USEPA National Functional Guidelines, USEPA Regions I through V, and NYSDEC DUSRs. Ms. Denly developed internal protocols for the validation of the MassDEP EPH/VPD methodologies.

With respect to references, serving as an in-house quality control and chemistry expert, Ms. Denly does not have extensive direct client contact.

REPRESENTATIVE EXPERIENCE (Descriptions marked with an asterisk (*) undertaken within past three years) New York City School Construction Authority*

Ms. Denly has provided quality assurance management for a variety of SCA programs, including PCB air monitoring, site investigations, and sub-slab soil vapor and indoor air investigations. In this role, Ms. Denly is responsible for reviewing field team documentation, providing oversight of the analytical laboratory, data validation, and preparation of DUSRs. She is responsible for frequent communication with the laboratories to ensure proper receipt of samples, proper utilization of project-specific analytical protocols in order to achieve necessary project action levels, and to monitor the overall performance of the laboratories.

Brownfields Programs – Various Locations*

Ms. Denly serves as the Project Quality Assurance Manager on TRC's Brownfields programs within USEPA Regions 1 and 3. In this role, she is responsible for maintaining and updating the USEPA-approved generic Brownfields QAPPs. She provides final review of site-specific QAPP addenda prepared for the individual Brownfields sites and assists in the determination of required analytical methodologies necessary to achieve specific project objectives. Ms. Denly is the point of contact for the field team and the laboratory during the investigations for issues related to the ultimate usability of the analytical data. She reviews the chains-of-custody as samples are received by the laboratory to ensure the

requirements for sample collection in the sitespecific QAPP addenda are followed and samples are properly logged into the laboratory. Final review of the analytical data is performed by Ms. Denly and a data usability assessment is generated for each investigation.

Vieques Island, Environmental Cleanup Oversight, Vieques, Puerto Rico* Ms. Denly provides technical and regulatory compliance oversight to the Commonwealth of Puerto Rico and the Puerto Rico Environmental Quality Board (EQB) regarding the investigation, assessment, and remediation of contamination on Vieques Island by the U.S. Navy in support of the property's transfer to the Commonwealth of Puerto Rico. Ms. Denly conducts technical and regulatory reviews pertaining to analytical methods and QA/QC issues of the documents prepared by Navy subcontractors including draft and final submissions of work plans, field sampling plans, investigation results, technical memoranda, feasibility studies, and remedial designs.

Massachusetts Department of Environmental Protection – MA*

Ms. Denly is currently providing assistance to MassDEP to determine whether the regulated community is correctly implementing analytical methodologies at MassDEP sites; this includes providing training for all MassDEP auditors. Ms. Denly is also assisting MassDEP in the development of a protocol for the analysis of volatile petroleum hydrocarbons (VPH) by GC/MS. Previously, Ms. Denly has assisted MassDEP in the review/evaluation of data packages for EPH/VPH analyses from laboratories selected by MassDEP as part of a Data Audit project to ensure compliance with the methods and CAM. She provided consultation to MassDEP for revisions to the MassDEP's innovative EPH/VPH analytical methods used to measure petroleum hydrocarbon concentrations in soil and groundwater. Ms. Denly served as a member of the Data Quality Enhancement Work Group led by MassDEP and assisted in the development of a policy for achieving consistency of data reported under the MCP. Ms. Denly was responsible for generating the framework for QC parameters on organic analyses typically utilized under the MCP, method-specific performance standards for these QC parameters, minimum reporting requirements for the laboratories for each method, and a list of what laboratories need to keep on file for potential audits by the MassDEP.

Mattiace Petrochemical Superfund Site – Glen Cove, NY*

Ms. Denly prepared the QAPP for the Long Term Remedial Action under TRC's Exit Strategy® program using USEPA Region II guidance. She provides QA oversight to the field team. Ms. Denly also performs data validation of data generated for demonstration of achievement of cleanup objectives. Ms. Denly is responsible for performing assessment of data to determine overall usability.

USEPA Region I Superfund RAC*

Ms. Denly serves as lead chemist for a variety of Superfund programs under the USEPA Region I Remedial Action Contract (RAC). Her responsibilities have included ongoing development of analytical specifications for laboratories to achieve specific project objectives and development of QAPPs following the requirements of USEPA Region I QAPP guidelines. She performs data validation and/or senior review of data validation for a variety of analytical methodologies utilizing USEPA Region I validation guidelines. Ms. Denly generates data usability assessments and/or split sample comparison reports in accordance with USEPA Region I guidance, when required. She interacts with USEPA Region I chemists in the selection of analytical methodologies and project objectives. Ms. Denly provides QA oversight of PRPs' validation reports, sampling and analysis plans, and QAPPs. She is also responsible for providing QA oversight to field teams, performing daily reviews of COCs and traffic reports, and acting as the main liaison between the field team and USEPA.

FAA, Region II – Atlantic City, NJ

Ms. Denly assisted in the preparation of QA protocols for the Supplemental RI and Ecological Risk Assessment Work Plan. She was also responsible for providing QA support to the field team. Ms. Denly interfaced with laboratories to ensure achievement of risk-based standards and performed data validation and/or oversight for all data generated. Ms. Denly provided oversight for all validation performed on the Remedial Investigation data.

Queens West Development – Stage 2 Site – Long Island City, NY

Ms. Denly prepared the QAPP for the NYSDEC Voluntary Cleanup Program under TRC's Exit Strategy® program. She provided QA oversight to the field team. Ms. Denly performed data validation for the program. She was responsible for performing assessment of data to determine overall usability. Ms. Denly provided daily support to the project team on chemistry, laboratory, and QA issues. She was responsible for ensuring project objectives were achieved by the laboratory and for oversight of laboratory QA issues.

Consolidated Edison First Avenue Properties – New York, NY

Ms. Denly prepared a QAPP for Supplemental Soil Investigation and Voluntary Cleanup of four sites under TRC's Exit Strategy® program. The First Avenue Properties Site is the site of a former Consolidated Edison Power Plant located in midtown Manhattan between East 38th Street and East 40th Street. Ms. Denly provided QA oversight to field team during site remediation. Ms. Denly performed data validation of select data points used for decision-making and was responsible for performing assessment of data to determine overall usability for various Remedial Work Plans.

130 Liberty Street – New York, NY

Ms. Denly developed the QAPP for the extensive ambient air monitoring program and waste management program under USEPA Region II oversight. Ms. Denly provided oversight of six analytical laboratories and was responsible for coordination and performance of data validation for asbestos, metals, dioxins/furans, PAHs, PCBs, and silica ambient air data as well as TCLP and metals waste characterization data. Ms. Denly communicated frequently with the laboratories to ensure proper receipt of samples, proper utilization of projectspecific analytical protocols and to monitor the overall performance of the laboratories. Responsible for the oversight and performance of field and laboratory audits. Reviewed all data prior to web-site posting and submission to USEPA.

PUBLICATIONS AND PRESENTATIONS

Denly, E., "LOQ, LOD, DL, RL, QL, SQL, MDL, PQL: What the "L"?" Presented at Thirty-first Annual International Conference on Soils, Sediments, Waters, and Energy, Amherst, MA. 2015.

Denly, E. Chapnick, S., "*Is Presumptive Certainty Generating Usable Data for Massachusetts Contingency Plan (MCP) Decisions?*" Paper presented at Twentieth Annual Conference on Contaminated Soils, Sediments and Waters, Amherst, MA. 2004.

Denly, E., Hoyt, M., Anastas, N., Fitzgerald, J., Hutcheson, M., McGrath, T., "*Massachusetts VPH Method Validation for Indoor Air Samples*". Poster presented at Thirteenth Annual Conference on Contaminated Soils, Amherst, MA. 1998.

Denly, E. Hopper, D., "*Field Chemistry for PAHs and VOCs Applied to a RiskBased Soil Cleanup at a Landfill*", Paper presented at Fifth International Symposium on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, NV. 1997.

Denly, E., Hoyt, M., Camp, W.H., Naughton, G., "*Method Validation Study for Field Screening of Dielectric Fluids in Soils*", Paper presented at Twelfth Annual Conference on Contaminated Soils, Amherst, MA. 1997.

Denly, E., Wang, H., "*Preparation of Tedlar Bag Whole Air Standards with a SUMMA Canister for Field VOC Analysis*", Poster presented at Fourth International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals, February 22-24, 1995, Las Vegas, NV.

SPECIALIZED TRAINING

- Data Evaluation for Vapor Intrusion Studies, 9/07

- Sediment Toxicity Testing: Methods to Achieve Strong Data Sets and Interpret Results, 6/07
- Assessing the Vapor Intrusion Pathway at Contaminated Sites, NHDES Waste Management Division, 4/05
- Perchlorate Webinar, USEPA, 2/05
- Improved Project Communication: Within and Outside of the Project Team, ASCE Continuing Education Program, 12/15/04
- Communicating with Tact and Skill for Managers and Supervisors, Rockhurst University Continuing Education Center, 2004
- Training Session for USACE-NAE/USEPA Region I Regional Implementation Manual, 10/7/04
- Training for Non-Trainers, USEPA, 9/04
- Overview of Statistical Data Quality Assessment, USEPA, 9/04
- Assessing Quality Systems, USEPA, 9/04
- Understanding and Evaluating Data Quality Assessments, USEPA, 9/28/04
- PowerPoint 2000 – Level 1, New Horizons Computer Learning Centers, 12/03
- USEPA Forms II Lite Training Course, 9/23/03



Emily P. Ebert
Project Manager

Areas of Expertise

- *Project Management*
- *Environmental Site Assessment and Investigation*
- *Environmental Regulatory Compliance*
- *Remedial Activity Oversight and Management*
- *Non-Hazardous and Hazardous Waste Management*
- *Soil, Groundwater, and Soil Vapor Remedial Investigations*
- *Soil Vapor Intrusion Investigation*
- *Remedial Action*
- *Ambient and Community Air Monitoring*
- *Indoor Air Quality Assessments*

Emily Ebert possesses more than seven years of environmental consulting experience which includes preparing Phase I Environmental Site Assessment (ESA) reports, implementing Phase II Environmental Site Investigations (ESIs) and preparing Phase II ESI reports, managing Remedial Investigation (RI) activities for sites with petroleum, chlorinated solvent, PCB, and heavy metal contamination; oversight of Remedial Actions and IRMs; environmental health and safety oversight; and managing a variety of environmental sampling programs for groundwater, surface water, soil, sediment, and soil gas and soil vapor intrusion. Ms. Ebert is based in TRC's New York City office.

CREDENTIALS

Education

- BS, Environmental Science, University of Vermont, 2013

Professional Certifications/Training:

- OSHA 40-Hour HAZWOPER Training and 8-hour Refresher
- OSHA 10-Hour Construction Safety Training
- 24-Hour USEPA Asbestos Inspector
- State of New York Asbestos Consultant
- Transit Worker Identification Credential (TWIC) holder
- Red Cross First Aid/CPR/AED Certified

REPRESENTATIVE EXPERIENCE

New York City School Construction Authority (NYCSCA) – Multiple Sites – New York City

Ms. Ebert is a Project Manager responsible for performing site assessments, investigations, and oversight of remediation actions for new construction and renovation of New York City public schools. Responsibilities include Phase I ESAs, Phase II ESIs, indoor air quality (IAQ) investigations, outdoor air assessments, and SVI assessments. Ms. Ebert has successfully prepared over 75 Phase I Environmental Site Assessments for properties located in Queens, Brooklyn, Manhattan, and the Bronx. Additionally, Ms. Ebert routinely provides recommendations and prepares Phase II Environmental Site Investigation Scopes of Work which adequately address all recognized environmental conditions identified during completion of the Phase I Environmental Site Assessment.

Ms. Ebert has served as project scientist for management of remedial activities and IRMs for public school sites that are in the NYSDEC Brownfield Cleanup Program (BCP), including authoring Interim Remedial Measure (IRM) work plans, RI reports, Remedial Action Work Plans (RAWPs), and Construction Completion Reports (CCRs).

Ms. Ebert has also served as Project Manager for PCB remedial actions at public schools. Ms. Ebert's responsibilities have included daily communication and project coordination with NYCSCA Project Managers and contractors, supervision of field staff, and review of work products (including summary reports, surface soil investigation reports and PCB soil remediation reports).

New York City Economic Development Corporation (NYCEDC)

Ms. Ebert serves as project manager for tasks relating to environmental due diligence. Ms. Ebert has prepared Phase I ESA reports for submittal to the New York City Economic Development Corporation. In addition, Ms. Ebert has successfully managed the implementation of Indoor Air Quality Investigations for over 60 properties located in New York City. The Investigations were completed on an expedited turnaround time.

The Port Authority of NY & NJ (PANYNJ)

Ms. Ebert serves as project scientist for activities related to Howland Hook Marine Terminal (HHMT) - Port Ivory Facility, which includes three former Voluntary Cleanup Program (VCP) Sites. Ms. Ebert's responsibilities include periodic inspections of the environmental caps, review of annual groundwater and surface water monitoring data, and preparation of annual periodic review reports in accordance with Site Management Plans (SMP) for each Site. Additionally, Ms. Ebert serves as a project scientist responsible for conducting biannual site-wide gauging events (at over 200 wells) at the Bulk and Satellite Fuel Farms to track remedial progress.

New York City Department of Parks and Recreation

Ms. Ebert serves as project manager in connection with the construction and reconstruction of park facilities in New York City. Specifically, Ms. Ebert serves as Project Manager for the Environmental Engineering Services in connection with Plant 2 at Fresh Kills Park. Ms. Ebert's responsibilities include preparation of a Remedial Investigation Work Plan and implementation of a Geotechnical Investigation. In addition, Ms. Ebert serves as Project Manager for the Environmental Engineering Services in connection with Mariners Marsh Park. Ms. Ebert's responsibilities include review of existing background materials and preparation of a Records Search Report. Ms. Ebert also served as a project scientist providing consulting services in connection with the environmental design, construction and reconstruction of park buildings and facilities in New York City. Responsibilities included implementation and oversight during permeability testing and subsurface investigations and preparation of subsurface investigation reports.

New York State Department of Environmental Conservation (NYSDEC) Superfund Standby Contract

Under TRC's contract with the NYSDEC to provide environmental engineering services for investigation and remediation of State Superfund sites, Ms. Ebert has served as a project scientist in connection with Remedial Investigations at several project sites including Bridge Cleaners Site in Long Island City, NY and Gem Cleaners in Rockville Centre, NY. Her responsibilities have included implementation of soil vapor intrusion and groundwater sampling, quality assurance/quality control reviews of analytical data summary tables presenting soil and groundwater sampling results, and preparation of remedial investigation reports.

Cypress Creek Renewables – New York State

Ms. Ebert serves as a Project Manager performing due diligence assessments in support of development of solar facilities. Responsibilities included completion of Phase I Environmental Site Assessments (ESAs), Phase I ESA updates, and Phase II Environmental Site Investigations (ESIs) for over 40 sites throughout New York State. Each site encompasses between approximately two and 150 acres and up to 6 Phase I ESAs were completed concurrently.

Civic Builders

Ms. Ebert serves as project manager for tasks relating to environmental due diligence and subsurface investigation services for Civic Builders, a developer of new charter schools in New York City. Ms. Ebert has been responsible for preparation of Phase I Environmental Site Assessment reports and Phase II Environmental Site Investigation reports. In addition, Ms. Ebert has reviewed a Hazardous Materials Remedial Investigation (RI) for a redevelopment project enrolled in the New York City Office of Environmental Remediation (OER) Voluntary Cleanup Program.

New York Power Authority (NYPA)

On behalf of New York Power Authority (NYPA), Ms. Ebert served as a project scientist in connection with the closure of the Hazardous Waste Drum Storage Area (HWDSA) activities at the Former Charles Poletti Power Project located in Queens, New York. The Former Charles Poletti Power Project is located adjacent to the former Astoria Manufactured Gas Plant (MGP). During the subsurface investigation activities completed as part of the HWDSA closure, Ms. Ebert inspected soil borings for evidence of MGP waste. The HWDSA was closed in accordance with the New York State Department of Environmental Conservation hazardous waste management closure performance standards.



CHARLES LAMBERT

EDUCATION

B.S., Environmental Science, University of Massachusetts Amherst, 2015

AREAS OF EXPERTISE

Mr. Lambert possesses four years of environmental consulting experience, encompassing:

- Phase II Environmental Site Investigations (ESI)
- Underground Storage Tank (UST) and Aboveground Storage Tank (AST) Closure and Removal
- Remedial Investigation Work Plan implementation and oversight
- Soil, groundwater, and soil vapor intrusion investigations
- Implementation of Community Air Monitoring Plans
- Regulatory Compliance
- Environmental Liability Management

Mr. Lambert is an Environmental Scientist with four years of experience in environmental consulting. His experience includes completion of Phase II ESIs including soil, groundwater, and soil vapor intrusion investigations and report writing, underground and aboveground storage tank management, and remedial excavation oversight. Mr. Lambert's background includes services for the New York State Department of Environmental Conservation (NYSDEC) and private clients including numerous banks and clients in the oil & gas industry.

SUMMARY OF EXPERIENCE

A summary of Mr. Lambert's employment history is presented below.

- Staff Professional, Antea Group, 1/26/2015 – 2/24/2017
- Staff Scientist, Castleton Environmental, 2/27/2017 – 10/4/2019
- Environmental Scientist, TRC, 10/9/2019 – Present

REPRESENTATIVE EXPERIENCE

Relevant examples of Mr. Lambert's experience are provided below.

BP, Environmental Site Assessments – Various Locations, NY

Mr. Lambert conducted field assessments of BP sites throughout the five boroughs and state of New York. Investigations included the screening and sampling of soil and groundwater, quarterly groundwater monitoring and reporting, product recovery, and underground storage tank management. In addition, Mr. Lambert assisted with remedial activities including UST closure and removal and oversight of remedial excavations. Mr. Lambert's responsibilities included communication with the Clients and contractors; review of analytical data generated; supervision of contractors; and preparation of work products, including tabulation of data, Site Investigation Reports, and Quarterly Groundwater Monitoring Reports.

Kinder Morgan, Operations and Maintenance – Various Locations, NY

Mr. Lambert assisted with environmental remediation services by performing operations and maintenance on the product recovery system and groundwater treatment system at the Kinder Morgan Brooklyn terminal. Responsibilities included bi-weekly system inspections, monitoring and recovery well gauging, and O&M as necessary. In addition, Mr. Lambert performed quarterly groundwater treatment system water sampling, quarterly air discharge sampling, and coordinated with client and contractors for product disposal.

Getty Realty, Environmental Assessments – Various Locations, NY

Mr. Lambert conducted field assessments of Getty Realty sites throughout the five boroughs and state of New York. Investigations included the screening and sampling of soil and groundwater, preparation of boring logs, as well as underground storage tank assessments. In addition, Mr. Lambert performed oversight during implementation of remedial activities including UST closure and removal and remedial excavations. Additionally, Mr. Lambert provided contractor oversight of BOS 200 Trap & Treat in situ chemical injection events at three sites, each consisting of up to approximately 50 injection locations on-site to address residual petroleum impacts in the soil and groundwater.

Lions Group NYC, Environmental Consulting – Queens, NY

Mr. Lambert provided a range of environmental consulting services for Lions Group NYC including soil classification assessments, soil removal management, implementation of community air monitoring programs, underground storage tank management, and oversight during spill remediation including excavation of petroleum contaminated soil and collection of post-excavation soil samples for numerous sites in Queens, NY.

Various Private Banks, Environmental Liability Management – Various Locations, NY

Mr. Lambert served as an environmental consultant during real-estate transactions performing Phase II ESAs. Investigations included soil, groundwater, and soil vapor intrusion assessments and any associated remediation activity.

SPECIALIZED TRAINING

- 40-Hour OSHA HAZWOPER Training
- OSHA 10-Hour Construction Safety and Health
- OSHA 30-Hour Construction Safety and Health