

**REMEDIAL INVESTIGATION WORK PLAN**

**for the**

**PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET  
BROOKLYN, NEW YORK 11209  
BLOCK 6065, LOTS 28 AND 39**

**NYSDEC BROWNFIELD CLEANUP PROGRAM SITE NO.: C224327**

**SITE NAME: FORMER GIUFFRE AUTO GROUP SITE**

**SCA PROJECT ID NO. 118924  
SCA CONTRACT NO. C000015348  
SCA SERVICE ID NO. 81213**

**TRC PROJECT NO. 435632**

**MARCH 2022**

**Submitted to:**

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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.  
NYS Professional Engineer No. 096717

\_\_\_\_\_  
March 17, 2022  
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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**ABBREVIATIONS AND ACRONYMS**

µg/m <sup>3</sup>	Micrograms per cubic meter
ACM	Asbestos-Containing Materials
ASP	Analytical Services Protocol
AST	Aboveground Storage Tank
BBOS	Below the Bottom of Slab
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BGS	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CAMP	Community Air Monitoring Plan
Cis-1-2-DCE	cis,1-2-Dichloroethene
Class GA Value	New York State Class GA Groundwater Standard
CP-51	Commissioner Policy 51
DER	Department of Environmental Remediation
DER-10	DER Technical Guidance for Site Investigation and Remediation
DO	Dissolved Oxygen
DQO	Data Quality Objectives
DUSR	Data Usability Summary Report
ELAP	Environmental Laboratory Approval Program
ESA	Environmental Site Assessment
ESI	Environmental Site Investigation
HASP	Health and Safety Plan
IDW	Investigation Derived Waste
LBP	Lead-Based Paint
LNAPL	Light Non-Aqueous Phase Liquid
MCL	Maximum Contaminant Level
NTU	Nephelometric Turbidity Unit
NYCDCP	New York City Department of City Planning
NYCRR	New York Codes, Rules, and Regulations
NYCSCA	New York City School Construction Authority
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation Reduction Potential
PBS	Petroleum Bulk Storage
PCB	Polychlorinated Biphenyl
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic Acid

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**ABBREVIATIONS AND ACRONYMS (CONTINUED)**

PFOS	Perfluorooctanesulfonic Acid
PCE	Tetrachloroethene
PID	Photoionization Detector
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
REC	Recognized Environmental Condition
RI	Remedial Investigation
SCO	Soil Cleanup Objective
SF	Square-Foot
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compound
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

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## **1.0 INTRODUCTION**

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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 8802 5th Avenue and 429 89th Street, Brooklyn, New York 11209 (referred to as the “Site”). The New York City School Construction Authority (NYCSCA), a New York State Public Benefit Corporation, purchased the Site in August 2021 for construction of a Public School Facility. The Site was accepted into the Brownfield Cleanup Program (BCP) as a Volunteer. The BCP Site name is “Former Giuffre Auto Group Site” and the BCP Site Number is C224327.

The overall objectives of the project are to prepare the Site for construction of a Public School Facility, a Restricted-Residential Use, and to remediate the environmental conditions at the Site to the satisfaction of New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH).

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).

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

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### 2.1 Site Location and Setting

The Site is located at 8802 5th Avenue and 429 89th Street, Brooklyn, New York 11209. The legal description of the Site is Block 6065, Lots 28 and 39. The Site encompasses approximately 31,659 square feet (sf) and is improved with a one-story commercial building with a basement and an asphalt-paved parking lot on Lot 28 (8802 5th Avenue), and a commercial building with a partial basement on Lot 39 (429 89th Street). Lot 28 is approximately 21,659 sf and contains a one-story commercial building with a gross floor area of approximately 13,835 sf that is currently subdivided into two units which are currently vacant. Lot 39 is approximately 10,000 sf and is improved with a one-story commercial building with a partial basement that is currently vacant and was most recently used by a construction company for storage of tiles and other assorted construction materials. The Site location is shown on *Figure 1*.

The Site is bordered to the north by 88th Street followed by a health care facility (“Langone Medical Arts”); to the east by 5th Avenue followed by institutional/commercial buildings (the United States Post Office and an automobile sales facility); to the south by 89th Street, followed by commercial buildings; and to the west by automobile showrooms with repair facilities, NYC Department of Education Superintendent Office, and a commercial building (7-Eleven) followed by 4th Avenue. Beyond the properties immediately adjacent to the Site, property uses are commercial, residential, and institutional. 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 22b, the Site is zoned for commercial use (C8-2). The NYCSCA will coordinate any zoning changes as needed. Based on a review of the CEQR Environmental Designations as shown on NYCDCP Zoning Map 22b, Lots 28 and 39 are each listed with an “E”-Designation for Underground Gasoline Storage Tanks Testing Protocol and Air Quality.

### 2.2 Current Site Use

The Site is currently vacant.

### 2.3 Historic Site Use

Historically, Lot 28 was occupied by several low-rise structures prior to construction of the current one-story commercial building with a basement in 1956. The building was most recently used by a bank and as real estate offices. Lot 39 was improved with the current one-story building with a

partial basement since 1923, which was occupied by a garage with gasoline tank and auto repair/service station.

## **2.4 Future Use of the Site and Site Development Schedule**

The proposed future use of the Site is a Public School Facility. The preliminary proposed Site development includes demolition of the existing structures and construction of a five-story public school building with a cellar on the eastern portion of the Site and a play yard on the western portion of the Site. Additionally, the conceptual design for the school facility is subject to change during the design process.

The NYCSCA purchased the Site in August 2021. Following the completion of the RI and purchase of the Site, the NYCSCA will issue a design package for demolition of the existing structures (anticipated in Spring/Summer 2022), which may include a large portion of the remedial actions. NYCSCA's objective is to complete the remedy and obtain the Certificate of Completion by the summer of 2025.

## **2.5 Site Geology and Hydrogeology**

The subsurface geology of Kings County (Brooklyn) is characterized by Cretaceous strata between Precambrian bedrock consisting of gneiss and schist and Precambrian bedrock and Pleistocene glacial deposits. Present day surface features and topography in New York City are primarily attributable to the most recent glaciation event. The area is underlain by deposits of glacial outwash sediments, which are typically comprised of sand and gravel. Soil and bedrock stratigraphy throughout Brooklyn typically consists of a layer of historical fill that overlies glacial outwash sediments, unconsolidated deposits, and bedrock. The depth to bedrock in the area is estimated to be approximately 500 feet bgs.

Bedrock was not encountered during the Phase II Environmental Site Investigation (ESI). Fill material consisting of brown sand, gravel, trace building materials (i.e., red brick, asphalt, concrete) 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 red/brown poorly graded sand, well-graded gravel, silt, and clay.

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 southerly. During the Phase II ESI, groundwater was encountered at depths ranging from approximately 66 to 75 feet bgs.

### **3.0 PREVIOUS INVESTIGATIONS**

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Previous environmental reports associated with the Site include a Phase I Environmental Site Assessment (ESA) Report prepared by TRC in October 2019 and a Phase II Environmental Site Investigation (ESI) Report prepared by TRC in February 2020. 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, and 5, respectively.

#### **3.1 Phase I Environmental Site Assessment (ESA), October 2019**

A Phase I ESA for Block 6065, Lots 28 and 39 (the Site) was completed by TRC in 2019 on behalf of the NYCSCA. The Phase I ESA Report, dated October 15, 2019, identified on-Site recognized environmental conditions (RECs) associated with the potential presence of historic fill of unknown origin and suspect buried structures; a suspect aboveground storage tank (AST) in the basement of the 8802 5th Avenue building; historic use of the Site as a garage with a gasoline tank and auto repair/service station with a potential oil/water separator; the presence of volatile organic compounds (VOCs) and metals in soil above Unrestricted Use Soil Cleanup Objectives (SCOs) and the presence of chlorinated and petroleum-related VOCs in sub-slab vapor on Lot 39 (based on information provided by the property owner); and the Site's listing in the E-Designation database. Off-Site RECs include the current presence of auto repair facilities in close proximity to the Site; the historic presence of auto repair facilities, manufacturing facilities, gasoline filling stations, printers, undertakers, machine shops, bowling alleys, a sub-station, and a dry cleaner on nearby properties; as well as nearby sites identified in the regulatory database listings for spills, petroleum bulk storage tanks, E-designations, hazardous waste generation, and historical auto stations and dry cleaners. Environmental concerns include suspect asbestos-containing material (ACM), lead-based paint (LBP), and polychlorinated biphenyl (PCB)-containing materials, potential air emissions from the automobile repair facility located west of the Site on the Site block, and the potential for mold growth due to water intrusion.

Based on the results of the Phase I ESA, TRC recommended performing a Phase II ESI to determine whether the identified RECs affected the suitability of the Site for the construction of a Public School Facility. Environmental sampling was subsequently completed by TRC and is described below.

#### **3.2 Phase II Environmental Site Investigation (ESI), February 2020**

A Phase II ESI Report for the Site was prepared by TRC in February 2020 on behalf of the NYCSCA to assess the RECs identified in the Phase I ESA. Phase II ESI field activities consisted

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of a geophysical survey; investigation of an AST and floor drains/underground structures; advancement of soil borings; installation of temporary soil vapor probes and temporary groundwater monitoring wells; installation and development of one permanent monitoring well; and the collection and laboratory analysis of ambient air, sub-slab and soil vapor, soil, floor drain sediment, and groundwater samples.

The results of the geophysical survey revealed an anomaly resembling a potential underground storage tank (UST) in the 429 89th Street building. The anomaly was approximately 4.5 feet wide by 9 feet long. No fill ports or vent pipes were identified in the vicinity of the anomaly. Although several pipes which extend through the roof were identified along the southern wall of the 429 89th Street building, the results of the geophysical survey concluded these pipes were not vent pipes related to underground tanks.

An investigation of the suspect AST in the 8802 5th Avenue building confirmed the presence of an AST; however, the condition and approximate size of the AST could not be confirmed due to the condition of the concrete and cinder block enclosure. In addition, during the geophysical survey, an anomaly was identified below the concrete floor adjacent and parallel to the suspect AST in the 8802 5th Avenue building. The dimensions of the anomaly could not be confirmed due to interference by the wall and the AST.

Petroleum- and chlorinated solvent-related compounds were detected in soil vapor and sub-slab vapor above screening criteria. Specifically, the VOCs trichloroethene (TCE) and tetrachloroethene (PCE) were detected in sub-slab vapor and soil vapor at concentrations ranging from 0.16 to 710 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) and 5.3 to 15,000  $\mu\text{g}/\text{m}^3$ , respectively. Comparison of the sub-slab vapor analytical results to the NYSDOH Vapor Intrusion Guidance Matrices indicates that the recommended action would be mitigate, regardless of indoor air sampling results. In addition, VOCs were not detected in the ambient air sample at concentrations above screening criteria.

Two (2) sediment samples were collected from the floor drains in the 429 89th Street building. The VOC cis-1,2-dichloroethene (cis-1,2-DCE) (breakdown product of PCE) was detected in one floor drain sample and several semivolatile organic compounds (SVOCs) and several metals were detected in both sediment samples at concentrations exceeding Unrestricted Use Soil Cleanup Objective (SCOs) which are attributable to historic on-Site operations.

Total xylenes were detected in one (1) soil sample collected from soil boring TRC-SB-06 from 20 to 22 feet below ground surface (bgs) at concentrations marginally exceeding the Unrestricted Use SCO. Since black staining, petroleum odors, and elevated photoionization detector (PID) readings

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were encountered in one boring, TRC-SB-06, from approximately 10 to 22 feet bgs, total xylenes may be attributable to historic Site uses (i.e., automobile repair facility/garage with a potential UST and leaking subsurface drainage structure). No other petroleum-related VOCs were detected above comparison criteria in the sample. SVOCs and metals were detected in shallow soil samples (i.e., samples collected from 1 to 4 feet bgs/below the bottom of slab [bbos]) at concentrations above comparison criteria and are attributed to the characteristics of fill material at the Site. Polychlorinated biphenyls (PCBs), pesticides, and the herbicide Silvex were not detected in soil at concentrations above the Unrestricted Use SCOs. Perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) were not detected above the recommended Part 375 Unrestricted Use SCOs.

Three (3) soil samples and two (2) sediment samples collected from the floor drains were analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) for lead. Lead was not detected at concentrations exceeding the TCLP regulatory limit for toxicity. In addition, one (1) sediment sample collected from the westernmost floor drain was analyzed for chromium by TCLP. Chromium was not detected at a concentration exceeding the TCLP regulatory limit for toxicity. Note that the sediment from the floor drains was containerized and disposed of off-Site during the implementation of the Phase II ESI.

Chloroform was detected in groundwater at concentrations slightly above the New York State Class GA Groundwater Standard (Class GA Value). Chloroform is commonly found in potable drinking water as a by-product of chlorination and its presence was attributed to historic on-Site operations (i.e., leaking water pipes). Benzene, toluene, ethylbenzene, and xylenes (BTEX)-compounds and the SVOC phenol were detected in one (1) groundwater sample at concentrations above comparison criteria, which may be attributable to historic on-Site operations or an off-Site source. Metals (antimony, lead and manganese) were detected in filtered groundwater at concentrations above comparison criteria which are attributed to the characteristics of Site soil/fill. No PCBs were detected in groundwater at concentrations above the Class GA Value. In addition, PFOA and PFOS were not detected in groundwater at concentrations greater than the New York State Drinking Water Quality Council recommended Maximum Contaminant Level (MCL). Note that during the due diligence period, environmental data generated by the NYCSCA was transmitted to the property owner.



## **4.0 REMEDIAL INVESTIGATION OBJECTIVES AND METHODS**

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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 impacts previously identified during the Phase II ESI at one location, TRC-SB-06, 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 – Sub-Slab Vapor 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 13 soil borings (TRC-SB-06-N, TRC-SB-06-E, TRC-SB-06-W and TRC-SB-12 through TRC-SB-21). Please refer to *Figure 6* for the proposed boring locations. The soil sampling program will include the following:

- At two proposed locations (TRC-SB-16 and TRC-SB-17), a jackhammer and hand tools will be used to advance soil borings to refusal (estimated to be approximately 3 feet below bottom of slab [bbos]).
- 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 within the 429 89<sup>th</sup> Street building (TRC-SB-06-N, TRC-SB-06-E, TRC-SB-06-W, TRC-SB-12, TRC-SB-13, and TRC-SB-18 through TRC-SB-20) and a Sonic rig will be utilized to collect samples in 5-foot long, 3.5-inch diameter polyethylene bags at the three exterior locations (TRC-SB-14, TRC-SB-15, and TRC-SB-21). 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-06-N, TRC-SB-06-E, TRC-SB-06-W will be advanced to a depth of approximately 30 feet bgs.
  - TRC-SB-12 and TRC-SB-13 will be advanced to a depth of approximately five (5) feet bgs.

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- TRC-SB-14, TRC-SB-15, and TRC-SB-21 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 66 and 78 feet bgs, it is expected that the soil borings will be advanced to approximately 76 and 88 feet bgs.
  - TRC-SB-18 through TRC-SB-20 will be advanced to depths 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:
  - TRC-SB-16 and TRC-SB-17: Samples will be selected from 1 to 3 feet bgs.
- If no apparent impacted soils are identified, soil samples will be selected from the following depth intervals for laboratory analysis:
  - TRC-SB-06-N, TRC-SB-06-E, TRC-SB-06-W: Soil samples will be selected from 20 to 22 feet bgs to horizontally delineate the extent of impacts in TRC-SB-06. In addition, soil samples will be selected from 1 to 4 feet bgs.
  - TRC-SB-12 and TRC-SB-13: Soil samples will be selected from 1 to 4 feet bgs.
  - TRC-SB-14, TRC-SB-15, and TRC-SB-21: Soil samples will be selected from 1 to 4 feet bgs, 12 to 15 feet bgs, and the interval directly above the groundwater table.
  - TRC-SB-18 through TRC-SB-20: Soil samples will be selected from 1 to 4 feet bgs and 12 to 15 feet bgs.
- If impacted soils are identified, one soil sample will be selected from the most impacted zone (based on field screening), one soil sample will be selected from the first underlying apparent clean interval, and a third soil sample will be selected from the interval directly above the groundwater table, if encountered in the soil boring. If no apparent underlying clean interval is observed, the second soil sample submitted for

analysis will be the sample collected from the bottom interval of the boring, or the two-foot interval above groundwater, whichever is shallower.

- Soil samples will be analyzed for Target Compound List (TCL) and NYSDEC CP-51-listed VOCs plus the 10 highest concentration tentatively identified compounds (TICs)<sup>3</sup> will be reported, TCL and CP-51-listed semivolatile organic compounds (SVOCs) (including 1,4-dioxane) plus the 20 highest concentration TICs will be reported<sup>4</sup>, Target Analyte List (TAL) metals and cyanide, TCL pesticides, TCL herbicides, PCBs, and per- and polyfluoroalkyl substances (PFAS) compounds (refer to the QAPP in *Appendix A* for the specific list of PFAS compounds to be reported).
- Duplicate samples will be collected at a frequency of 1 per 20 soil samples and analyzed for the parameters listed above. Equipment blank samples will be collected at a frequency of 1 per day 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 6* for proposed monitoring well locations). Additionally, groundwater samples will be collected from one existing monitoring well on Lot 28.

Groundwater monitoring well installation and sampling will include the following:

- Soil borings TRC-SB-14, TRC-SB-15, and TRC-SB-21 will be converted to permanent monitoring wells TRC-GW-14, TRC-GW-15, and TRC-GW-21 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)

<sup>3</sup> 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.

<sup>4</sup> 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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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 four (4) on-Site wells (TRC-GW-04, TRC-GW-14, TRC-GW-15, and TRC-GW-21) will be gauged for non-aqueous phase liquid. The water table elevations (refer to Section 4.7) will be used to determine Site-specific groundwater flow. 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-GW-04, TRC-GW-14, TRC-GW-15, and TRC-GW-21) will be purged until 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-GW-04, TRC-GW-14, TRC-GW-15, and TRC-GW-21, plus one duplicate groundwater sample, will be analyzed for TCL and CP-51-listed VOCs plus TICs, TCL and CP-51-listed SVOCs (including 1,4-dioxane) plus TICs, TAL metals (field filtered and unfiltered), total cyanide, PCBs, TCL pesticides, TCL herbicides, 1,4-dioxane and PFAS<sup>5</sup>. Additionally, equipment blank samples will be collected at a frequency of 1 per day and analyzed for the parameters listed above and one (1) trip blank sample will be analyzed for TCL and CP-51-listed VOCs plus TICs.
- 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.

#### **4.6 Task 4 – Sub-Slab Vapor Sampling**

This task includes the collection of sub-slab vapor samples to determine the concentrations of VOCs in soil vapor. Four (4) sub-slab vapor samples (TRC-SSV-12, TRC-SSV-13, TRC-SSV-16, and TRC-SSV-17) will be collected at the locations shown on *Figure 6*.

Soil vapor 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 sub-slab 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

<sup>5</sup> Refer to the QAPP (Appendix A) for the PFAS to be reported.

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. During purging, the purge flow rate will not exceed 0.200 liters per minute (L/min). After purging, each probe will be connected via Teflon tubing to a laboratory-supplied individually certified clean 6-liter SUMMA canister. Using a 0.05 L/min flow regulator, the sample collection time will be approximately 120 minutes.

After sample collection, the sub-slab 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  $\mu\text{g}/\text{m}^3$ . NYSDEC ASP Category B deliverable packages will be provided.

Following sampling, sub-slab 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 pavement scars resulting from the 2019 and 2020 Phase II ESI sampling locations will be surveyed to aid in preparation of geologic cross-sections. Further, the property boundary limits will be surveyed.

#### **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.



**REMEDIAL INVESTIGATION WORK PLAN  
PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)  
BROOKLYN, NEW YORK 11209**

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## **5.0 PROJECT PERSONNEL**

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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**

<b>Name</b>	<b>Role</b>	<b>Phone Number</b>
Lee Guterman, NYCSCA	NYCSCA, IEH Division	(718) 472-8502
Bob Kanaparthi, NYCSCA	NYCSCA, IEH Division	(718) 472-8620 cellular: (917) 642-2742
Michael Sherwood, NYCSCA	NYCSCA, IEH Division	(718) 752-5211 cellular: (914) 400-5205
Kevin Boger, PE, TRC	TRC Remedial Engineer	(917) 983 - 3166
Jennifer Miranda, TRC	TRC Principal Scientist/Office Practice Leader	(917) 794 - 3248 cellular: (646) 285-8990
Lindsay O'Hara, CHMM, TRC	TRC Senior Project Manager	(917) 809 - 9372 cellular: (914) 420-9649
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
Elizabeth Denly, TRC	TRC Quality Assurance Officer	(978) 970-5600
William Poupis, ADT Drilling	Drilling Services	(516) 616-6026
Melissa Haas, Eurofins/TestAmerica	Laboratory Services	(203) 308 - 0880
Karolina Borowski, Perfect Point	Land Surveying Services	(718) 474-7700

## **6.0 REPORTING**

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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.

**REMEDIAL INVESTIGATION WORK PLAN  
PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)  
BROOKLYN, NEW YORK 11209**

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## **7.0 SCHEDULE**

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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.

<b><u>KEY MILESTONE</u></b>	<b><u>ESTIMATED TIME TO COMPLETION IN CALENDAR DAYS FROM EXECUTION OF THE BCA</u></b>
Execution of the BCA and NYSDEC Approval of RI Work Plan	0
Begin Remedial Investigation Field Activities	14
Complete Remedial Investigation (including laboratory analyses)	45
Submit Remedial Investigation Report to NYSDEC	90

## 8.0 REFERENCES

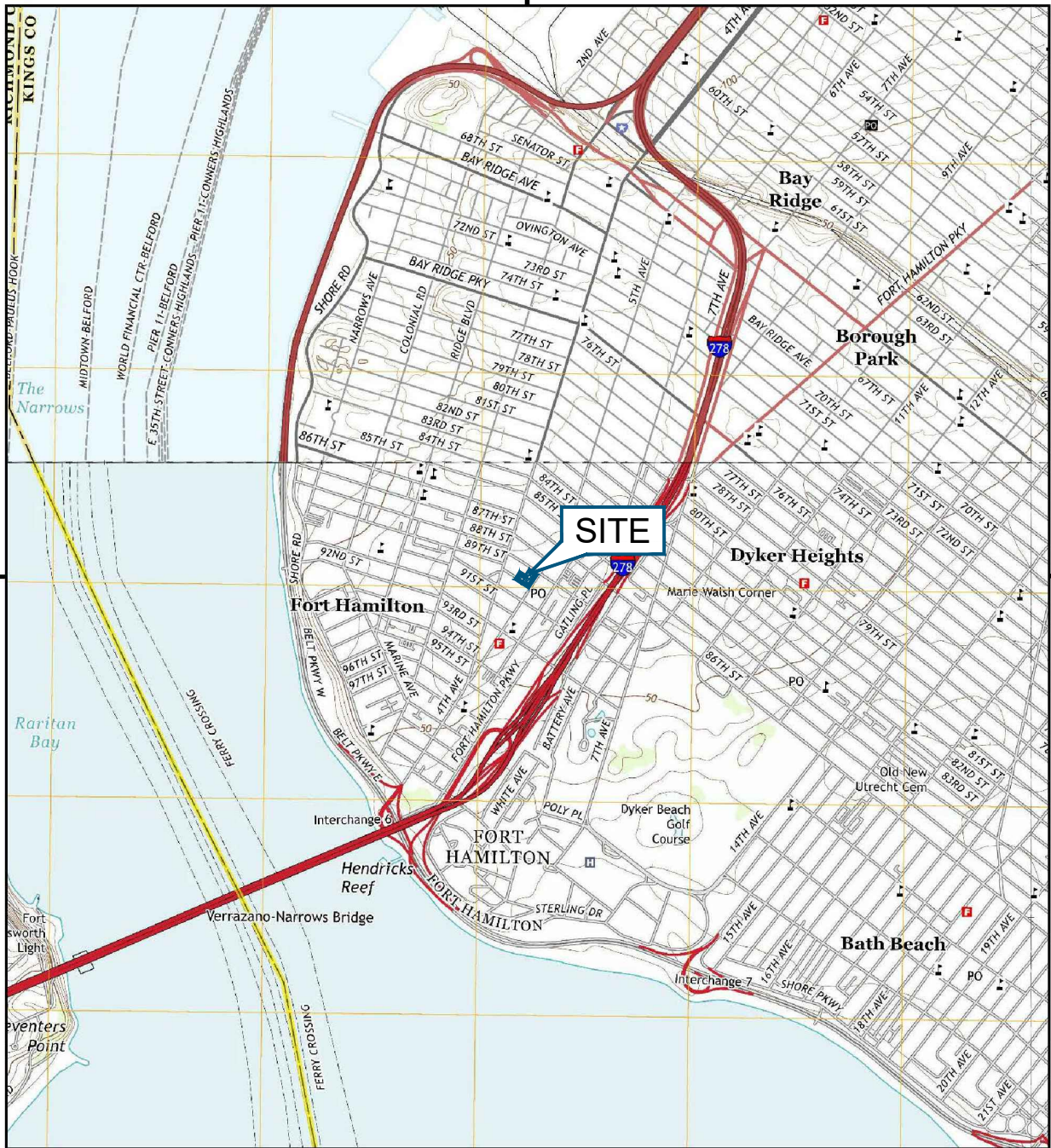
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1. 6 NYCRR 375: New York State Department of Environmental Conservation Rules and Regulations, Remedial Program Requirements.
2. 6 NYCRR 703, Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations.
3. ASTM E 2600-10 “Standard Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions.”
4. Bureau of Toxic Substance Assessment, New York State Department of Health, *Trichloroethene (TCE) In Indoor and Outdoor Air August 2015 Fact Sheet*.
5. Bureau of Toxic Substance Assessment, New York State Department of Health, *Tetrachloroethene (Perc) In Indoor and Outdoor Air September 2013 Fact Sheet*.
6. Buxton, Soren, Posner, and Shernoff, 1981, “Geologic Map of New York State.”
7. New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation, May 2010.
8. New York State Department of Health, “Guidance for Evaluating Soil Vapor Intrusion in the State of New York”, October 2006, as amended.
9. TRC Engineers, Inc., *Phase I Environmental Site Assessment of Proposed Public School Facility K20F - 8802 5th Avenue and 429 89th Street, Brooklyn, New York 11209*, October 15, 2019.
10. TRC Engineers, Inc., *Phase II Environmental Site Investigation Report of Proposed Public School Facility K20F - 8802 5th Avenue and 429 89th Street, Brooklyn, New York 11209*, February 28, 2020.

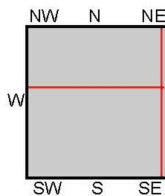
**REMEDIAL INVESTIGATION WORK PLAN  
PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)  
BROOKLYN, NEW YORK 11209**

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**FIGURES**



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



TP, The Narrows, 2013, 7.5-minute  
N, Jersey City, 2014, 7.5-minute  
NE, Brooklyn, 2013, 7.5-minute  
SE, Coney Island, 2013, 7.5-minute



SITE NAME: 8802 5th Avenue  
ADDRESS: 8802 5th Avenue  
Brooklyn, NY 11209



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

PROJECT:  
**NEW YORK CITY SCHOOL CONSTRUCTION AUTHORITY**  
**8802 5TH AVENUE AND 429 89TH STREET**  
**BLOCK: 6065, LOTS: 28 & 39**  
**BROOKLYN, NEW YORK 11209**

TITLE:

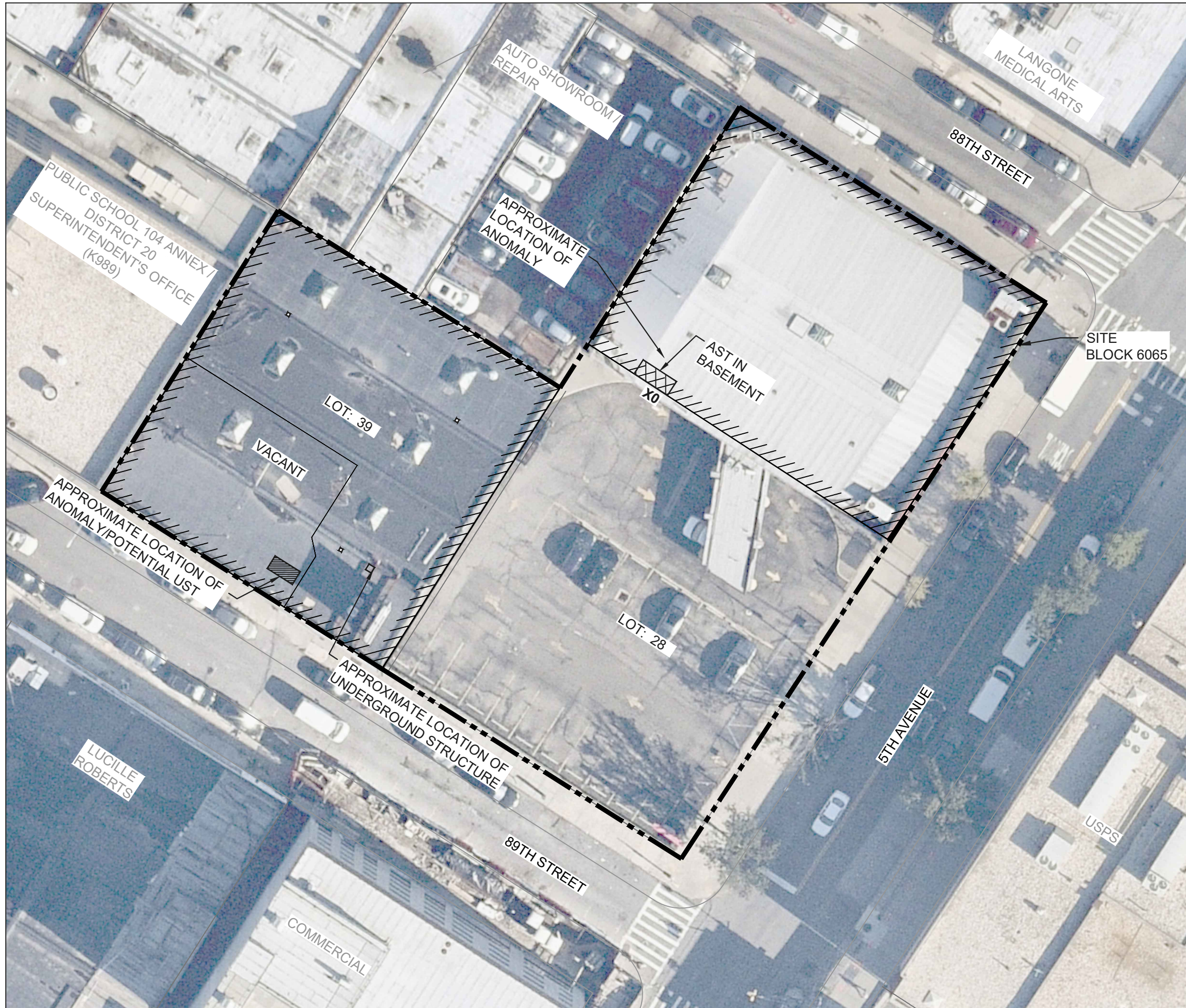
## SITE LOCATION MAP

DRAWN BY: H. DELGADO  
CHECKED BY: K. TREINEN  
APPROVED BY: L. O'HARA  
DATE: MARCH 2022  
PROJ. NO.: 435632  
FILE: Fig 1 - Site Location Map (K20F).dwg

## FIGURE 1



11x17 - ATTACHED XREFS - ATTACHED IMAGES: EPS6228B  
DRAWING NAME: \\nycc-fp-11\Projects\NYCSCA Contract C000015348436632 - K20F 8802 5th Ave Brooklyn\RI Work Plan\Figures\TRC Working Drawings\Fig 2 - Site Plan (K20F).dwg -- PLOT DATE: March 03, 2022 - 1:30PM -- LAYOUT: 11x17L



**LEGEND (SYMBOLS NOT TO SCALE):**

- SITE BOUNDARY
- LOT BOUNDARY
- BUILDING FOOTPRINT
- FLOOR DRAIN
- FILL PORT / VENT PIPE

**NOTE:**

- LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.
- AERIAL IMAGE BACKGROUND SOURCED FROM NEARMAP DATED OCTOBER 01, 2020.

SOURCE:  
BLOCK AND LOT BOUNDARIES DEPICTED  
FROM WWW.PROPERTYSHARK.COM

0 30' 60'  
SCALE: 1" = 30'  
SHEET SIZE: 11" BY 17"

ASSUMED  
GROUNDWATER  
FLOW DIRECTION



PROJECT: NEW YORK CITY SCHOOL CONSTRUCTION AUTHORITY 8802 5TH AVENUE AND 429 89TH STREET BLOCK: 6065, LOTS: 28 & 39 BROOKLYN, NEW YORK 11209			
TITLE: SITE PLAN			
DRAWN BY:	H. DELGADO	PROJ NO.:	435632
CHECKED BY:	K. TREINEN	FIGURE 2	
APPROVED BY:	L. O'HARA		
DATE:	MARCH 2022		
		1430 Broadway, 10th Floor New York, NY 10018 Phone: 212.221.7822 www.TRCompanies.com	
FILE NO.:		Fig 2 - Site Plan (K20F).dwg	



11x17 - ATTACHED XREFS: Brooklyn - ATTACHED IMAGES: 8802 5th Ave Brooklyn RI Work Plan Figures TRC Working Drawings Fig 3 - Sum. of Para. in Soil Ex. App. SCOs (K20F) dwg - PLOT DATE: March 03, 2022 - 1:33PM - LAYOUT: 11X17L  
DRAWING NAME: \\nycc-fp-11\Projects\NYCSCA Contract C000153484\63632 - K20F 8802 5th Ave Brooklyn RI Work Plan Figures TRC Working Drawings Fig 3 - Sum. of Para. in Soil Ex. App. SCOs (K20F) dwg

SAMPLE NAME	TRC-DRAIN-02
MATRIX	SEDIMENT
VOC (mg/kg)	1/14/2020
CIS-1,2-DCE	0.63
SVOC (mg/kg)	1/14/2020
BENZO(B)FLUORANTHENE	1.3
INDENO(1,2,3-CD)PYRENE	0.62 J
METALS (mg/kg)	1/14/2020
BARIUM	463
COPPER	295
CHROMIUM	69.4
LEAD	144
MERCURY	0.92
NICKEL	43.6
ZINC	1,130

SAMPLE NAME	TRC-DRAIN-01
MATRIX	SEDIMENT
SVOC (mg/kg)	11/8/2019
4- METHYLPHENOL	0.35 J
METALS (mg/kg)	11/8/2019
BARIUM	1,010
COPPER	724
CHROMIUM	248
LEAD	259
MERCURY	0.32
NICKEL	56.0
SILVER	3.5
ZINC	1,180

SAMPLE NAME	TRC-SB-06 (20-22)
MATRIX	SOIL
VOC (mg/kg)	11/8/2019
XYLENE (TOTAL)	0.29

PARAMETERS (mg/kg)	UNRESTRICTED USE SCO (mg/kg)	RESTRICTED RESIDENTIAL USE SCO (mg/kg)	PROTECTION OF GROUNDWATER SCO (mg/kg)
VOCs			
CIS-1,2-DICHLOROETHENE (CIS-1,2-DCE)	0.25	100	0.25
XYLENES (TOTAL)	0.26	100	1.6
SVOCs			
4- METHYLPHENOL	0.33	100	0.33
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
INDENO(1,2,3-CD)PYRENE	0.5	0.5	8.2
METALS			
BARIUM	350	400	820
COPPER	50	270	1,720
CHROMIUM	30	180	NO STANDARD
LEAD	63	400	450
MERCURY	0.18	0.81	0.73
NICKEL	30	310	130
SILVER	2	180	8.3
ZINC	109	10,000	2,480

SAMPLE NAME	TRC-SB-05 (1-4)
MATRIX	SOIL
METAL (mg/kg)	11/7/2019
MERCURY	0.62

SAMPLE NAME	TRC-SB-08 (1-4)
MATRIX	SOIL
SVOC (mg/kg)	11/6/2019
BENZO(A)ANTHRACENE	1.9
BENZO(B)FLUORANTHENE	2.1
CHRYSENE	2.0
BENZO(A)PYRENE	1.6
BENZO(K)FLUORANTHENE	0.88
INDENO(1,2,3-CD)PYRENE	1.0
METALS (mg/kg)	11/6/2019
LEAD	265
MERCURY	0.19
ZINC	287

SAMPLE NAME	TRC-SB-10 (1-3)
MATRIX	SOIL
METAL (mg/kg)	11/6/2019
NICKEL	30.5

SAMPLE NAME	TRC-SB-04 (1-4)
MATRIX	SOIL
SVOC (mg/kg)	11/4/2019
BENZO(B)FLUORANTHENE	1.1
CHRYSENE	1.1
METAL (mg/kg)	11/4/2019
NICKEL	57.2

SAMPLE NAME	TRC-SB-03 (1-4)
MATRIX	SOIL
METALS (mg/kg)	11/5/2019
COPPER	85.3
LEAD	456
MERCURY	0.25
NICKEL	34.4
ZINC	334

- NOTE:
- 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.
  - UST - UNDERGROUND STORAGE TANK.

LEGEND (SYMBOLS NOT TO SCALE):

- SITE BOUNDARY
- LOT BOUNDARY
- /// BUILDING FOOTPRINT
- X0 VENT LINE / FILL PORT
- ⌘ FLOOR DRAIN
- ⊙ SOIL, SOIL VAPOR, AND GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (NOVEMBER 2019)
- ⊗ TRC-SB-## / SV-## / GW-##
- ⊗ TRC-SB-## / SV-##
- ⊙ TRC-SB-## / SSV-##
- ⊙ TRC-AA-##
- ⊙ TRC-DRAIN-01
- ⊙ TRC-DRAIN-02
- ⊕ TRC-GW-02
- TRC-SB-1##

SOURCE:  
BLOCK AND LOT BOUNDARIES DEPICTED FROM  
WWW.PROPERTYSHARK.COM

0 40' 80'

SCALE: 1" = 40'

SHEET SIZE: 11" BY 17"

ASSUMED  
GROUNDWATER  
FLOW DIRECTION

PROJECT: NEW YORK CITY SCHOOL CONSTRUCTION AUTHORITY  
8802 5TH AVENUE AND 429 89TH STREET  
BLOCK: 6065, LOTS: 28 & 39  
BROOKLYN, NEW YORK 11209

TITLE: SUMMARY OF PARAMETERS IN SOIL EXCEEDING APPLICABLE SCOs

DRAWN BY: H. DELGADO PROJ NO.: 435632

CHECKED BY: L. O'HARA

APPROVED BY: J. MIRANDA

DATE: MARCH 2022

FIGURE 3

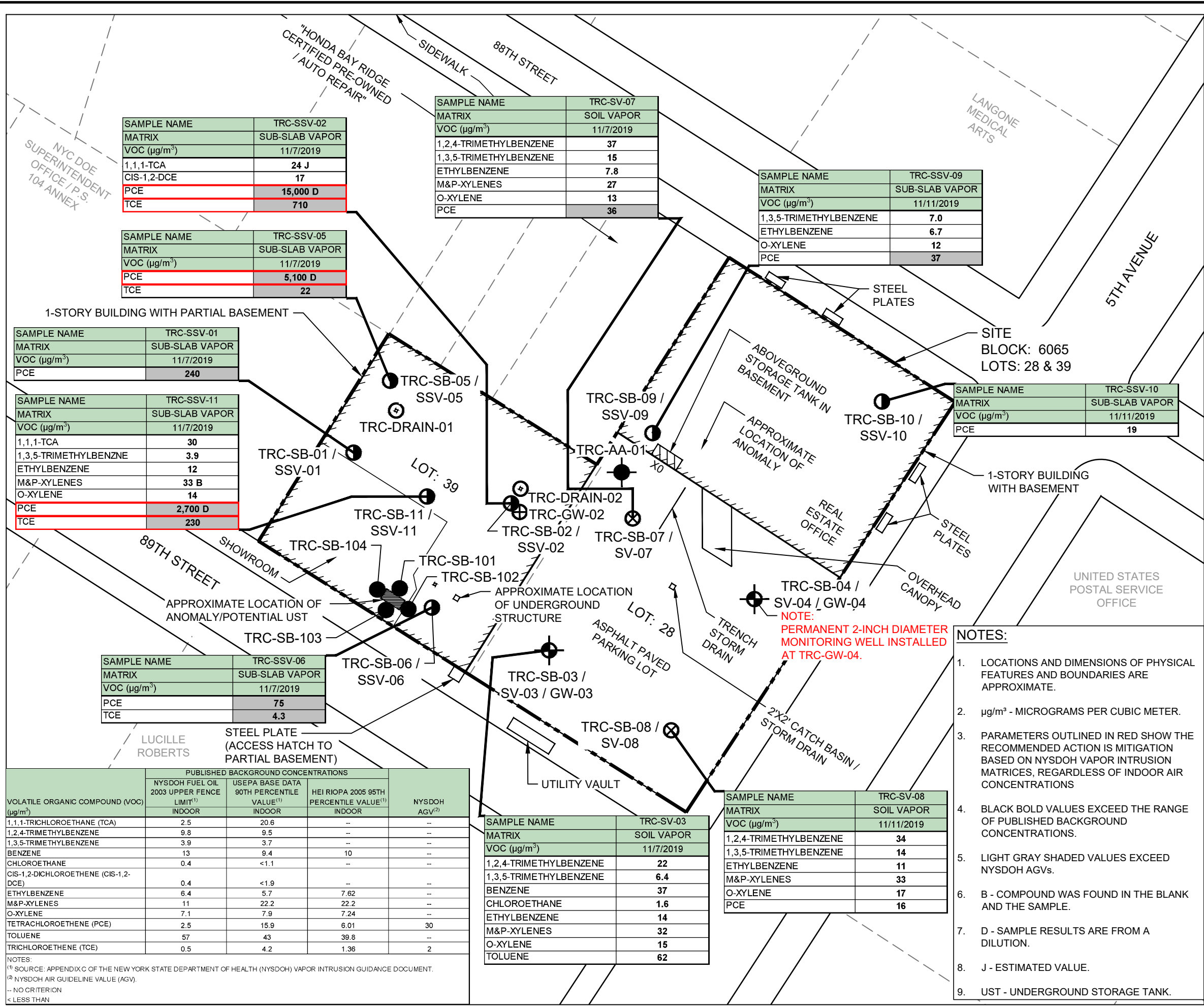
1430 Broadway, 10th Floor  
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FILE NO.: Fig 3 - Sum. of Para. in Soil Ex. App. SCOs (K20F) dwg

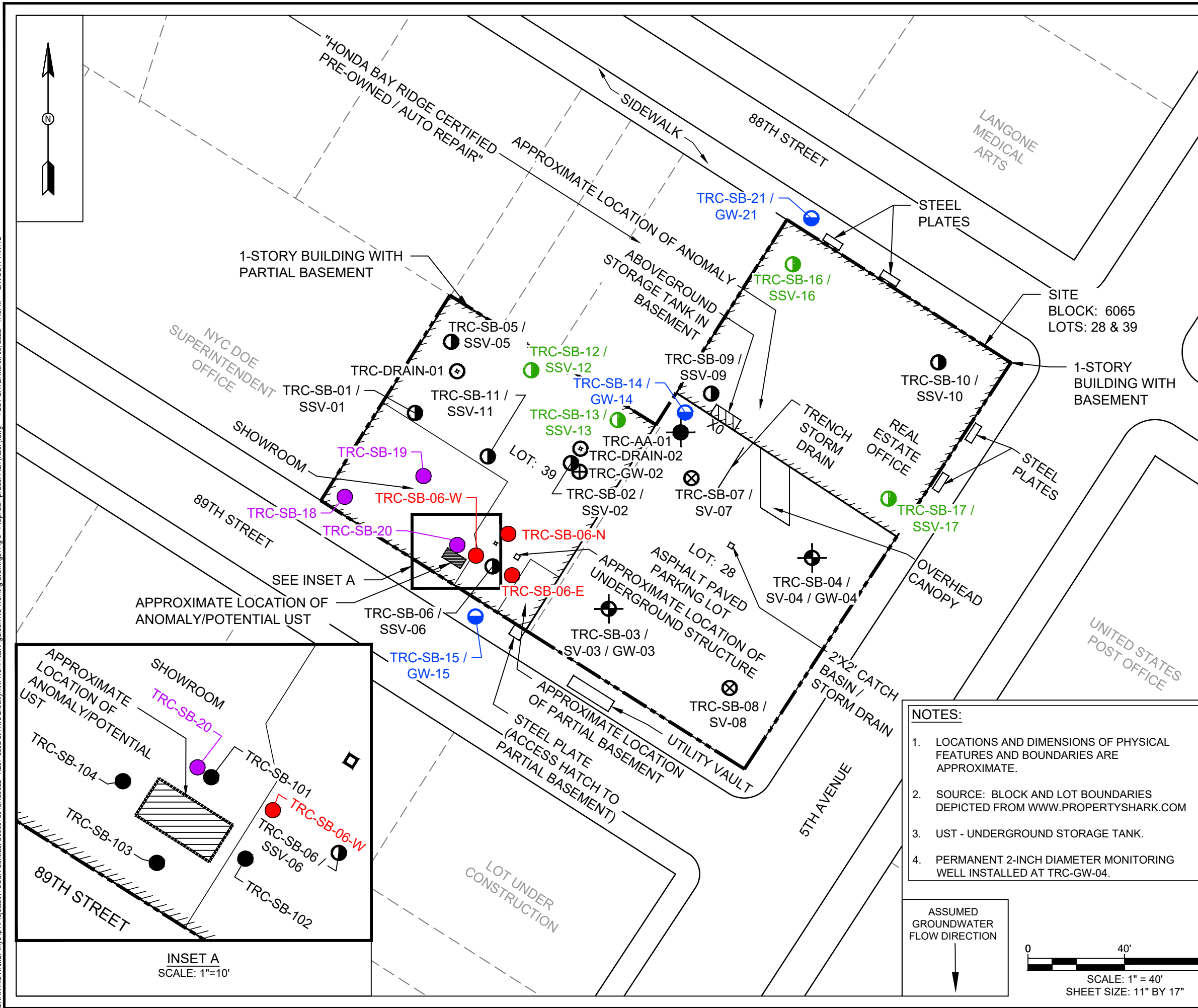





11x17 - ATTACHED XREFS: Brooklyn - ATTACHED IMAGES: 8802 5th Ave Brooklyn RI Work Plan Figures TRC Working Drawings Fig 5 - Sum. of VOCs in SV & SSV ex. Bckgrnd Conc.(K20F).dwg --- PLOT DATE: March 03, 2022 - 1:44PM --- LAYOUT: 11X17L  
DRAWING NAME: \\ny-cp-11\Projects\NYCSCA Contract C00001534843632 - K20F 8802 5th Ave Brooklyn RI Work Plan Figures TRC Working Drawings Fig 5 - Sum. of VOCs in SV & SSV ex. Bckgrnd Conc.(K20F).dwg







<b>PROJECT:</b> <b>NEW YORK CITY SCHOOL CONSTRUCTION AUTHORITY</b> <b>8802 5TH AVENUE AND 429 89TH STREET</b> <b>BLOCK: 6065, LOTS: 28 &amp; 39</b> <b>BROOKLYN, NEW YORK 11209</b>	
<b>TITLE:</b> <div style="text-align: center; font-size: 1.2em; font-weight: bold; margin-top: 10px;">             PROPOSED SAMPLE LOCATION PLAN           </div>	
<b>DRAWN BY:</b> H. DELGADO	<b>PROJ NO.:</b> 435632
<b>CHECKED BY:</b> L. O'HARA	<div style="font-size: 1.5em; font-weight: bold;">FIGURE 6</div>
<b>APPROVED BY:</b> J. MIRANDA	
<b>DATE:</b> MARCH 2022	
<div style="display: flex; align-items: center; justify-content: space-between;"> <div style="text-align: center;">  <div style="font-size: 2em; font-weight: bold; margin-top: 10px;">TRC</div> </div> <div style="text-align: right;"> <p>1430 Broadway, 10th Floor            New York, NY 10018            Phone: 212.221.7822  <a href="http://www.TRCCompanies.com">www.TRCCompanies.com</a></p> </div> </div>	
<b>FILE NO.:</b>	

**REMEDIAL INVESTIGATION WORK PLAN  
PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)  
BROOKLYN, NEW YORK 11209**

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**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. Data validation will be performed by Environmental Data Services, Inc. (EDS) of Palm Beach Gardens, FL. Specifically, the third-party data validator will be Nancy Weaver of EDS. 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  $\text{mg/kg}$ ). 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.

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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.

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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.

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<b>Table 1A</b> <b>Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Soil Samples</b>								
<b>Sample Matrix</b>	<b>Analytical Parameter</b>	<b>Sample Type<sup>1</sup></b>	<b>No. of Samples<sup>2</sup></b>	<b>No. of QA/QC Samples</b>	<b>EPA Analytical Method</b>	<b>Sample Preservation</b>	<b>Holding Time<sup>3</sup></b>	<b>Sample Container</b>
Soil	TCL and CP-51 VOCs	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	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 (includes 1,4-dioxane <sup>4</sup> )	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	8270D	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	TAL Metals	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	6010C	Cool to 4° C	Other metals: 180 days to analysis	8 oz glass jar
Soil	Mercury	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	7471B	Cool to 4° C	Mercury: 28 days to analysis	8 oz glass jar
Soil	Total Cyanide	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	SW 846 9012B	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	TCL Pesticides	Grab	23	Duplicate: 1/20	8081B	Cool to 4° C	14 days to extract	8 oz glass jar



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<b>Table 1A</b> <b>Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Soil Samples</b>								
<b>Sample Matrix</b>	<b>Analytical Parameter</b>	<b>Sample Type<sup>1</sup></b>	<b>No. of Samples<sup>2</sup></b>	<b>No. of QA/QC Samples</b>	<b>EPA Analytical Method</b>	<b>Sample Preservation</b>	<b>Holding Time<sup>3</sup></b>	<b>Sample Container</b>
				Equipment Blank: 1 per day				
Soil	TCL Herbicides	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	8151A	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	PCBs	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	8082A	Cool to 4° C	14 days to extract	8 oz glass jar
Soil	PFAS <sup>5, 6</sup>	Grab	23	Duplicate: 1/20 Equipment Blank: 1 per day	537 Version 1.1	Cool to 4° C	14 days to extract	250 mL plastic HDPE jar
<sup>1</sup> 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. <sup>2</sup> Actual number of samples may vary depending on field conditions, sample material availability, and field observations. <sup>3</sup> From date and time of sample collection <sup>4</sup> The reporting limit for 1,4-dioxane is 0.1 mg/kg. <sup>5</sup> 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/PFTTrDa), 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). <sup>6</sup> The lab is able to achieve a reporting limit of 0.2 ug/kg for PFAS compounds.								

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<b>Table 1B</b> <b>Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Groundwater Samples</b>								
<b>Sample Matrix</b>	<b>Analytical Parameter</b>	<b>Sample Type</b>	<b>No. of Samples<sup>1</sup></b>	<b>No. of QA/QC Samples</b>	<b>EPA Analytical Method</b>	<b>Sample Preservation</b>	<b>Holding Time<sup>2</sup></b>	<b>Sample Container</b>
Groundwater	TCL and CP-51 VOCs	Grab	4	Trip Blank <sup>3</sup> : as necessary (one per day, per cooler containing VOC groundwater samples) Duplicate: 1/20 Equipment Blank: 1 per day	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	4	Duplicate: 1/20 Equipment Blank: 1 per day	8270D	Cool, 4°C	14 days to analysis	2 250-ml amber glass jar
Groundwater	TAL Metals (unfiltered)	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	6010C	pH < 2 w/ HNO <sub>3</sub> ; Cool, 4°C	Other Metals: 180 days to analysis	500 mL polyethylene bottle
Groundwater	TAL Metals (field filtered)	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	6010C	pH < 2 w/ HNO <sub>3</sub> ; Cool, 4°C	Other Metals: 180 days to analysis	500 mL polyethylene bottle
Groundwater	Mercury (unfiltered)	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	7470A	pH < 2 w/ HNO <sub>3</sub> ; Cool, 4°C	Mercury: 28 days to analysis	250 mL polyethylene bottle
Groundwater	Mercury (field filtered)	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	7470A	pH < 2 w/ HNO <sub>3</sub> ; Cool, 4°C	Mercury: 28 days to analysis	250 mL polyethylene bottle
Groundwater	Total Cyanide	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	SW 846-9012B	pH < 2 w/ NaOH; Cool, 4°C	14 days to extract	250 mL polyethylene bottle
Groundwater	TCL Pesticides	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	8081B	Cool to 4° C	14 days to extract	2 250-ml amber glass jar

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<b>Table 1B</b> <b>Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Groundwater Samples</b>								
Sample Matrix	Analytical Parameter	Sample Type	No. of Samples <sup>1</sup>	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time <sup>2</sup>	Sample Container
Groundwater	TCL Herbicides	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	8151A	Cool to 4° C	14 days to extract	2 250-ml amber glass jar
Groundwater	PCBs	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	8082A	Cool to 4° C	14 days to extract	2 250-ml amber glass jar
Groundwater	1,4-Dioxane <sup>4</sup>	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	8270D SIM	Cool to 4°C	14 days to analysis	2 250-ml amber glass jar
Groundwater	PFAS <sup>5,6</sup>	Grab	4	Duplicate: 1/20 Equipment Blank: 1 per day	537 Modified	Cool to 4 ± 2 °C	14 days to prepare, 28 days from preparation to analysis	2 x 250 mL HDPE <sup>7</sup> Bottles
<sup>1</sup> Actual number of samples may vary depending on field conditions, sample material availability, and field observations. <sup>2</sup> From date and time of sample collection <sup>3</sup> Trip blank bottleware – 3 40-mL HCl-preserved glass vials <sup>4</sup> The method detection limit for 1,4-dioxane is 0.0160 ug/L and the reporting limit is 0.35 ug/L. <sup>5</sup> 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/PFTTrDa), 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). <sup>6</sup> The reporting limit for PFAS compounds is 2 ng/L with the exception of N-ethylperfluoro-1-octanesulfonamidoacetic acid (N-EtFOSAA), 1H,1H,2H,2H-perfluorooctane sulfonate (6:2 FTS), 1H,1H,2H,2H-perfluorodecane sulfonate (8:2 FTS), and Perfluorobutanoic acid (PFBA). The reporting limit for these four PFAS range from 3 to 5 ng/L. <sup>7</sup> HDPE – High density polyethylene								

<b>Table 1C</b> <b>Analytical Parameters, Methods, Preservation, Holding Time, and Container Requirements for Soil Vapor Samples</b>								
Sample Matrix	Analytical Parameter	Sample Type	No. of Samples	No. of QA/QC Samples	EPA Analytical Method	Sample Preservation	Holding Time <sup>1</sup>	Sample Container
Soil Vapor	VOCs	Grab	4	None	TO-15	None	30 days to analysis	One 6-L Summa Canister
<sup>1</sup> From date and time of sample collection								

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<b>Table 2A</b> <b>Laboratory Data Quality Objectives: Precision and Accuracy: Soil Samples</b>						
<b>Parameter</b>	<b>Method</b>	<b>Matrix</b>	<b>Accuracy Control Limits</b>	<b>Accuracy Frequency Requirements</b>	<b>Precision (RPD) Control Limits</b>	<b>Precision Frequency Requirements</b>
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
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>Field Duplicates</u> RPD ≤20	<u>Field Duplicates:</u> One per 20 soil samples

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				<u>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch		
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 $\leq$ 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 $\leq$ 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 $\leq$ 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>Laboratory Control Samples:</u> One per 20 samples per laboratory analytical batch	<u>Field Duplicates</u> RPD $\leq$ 20	<u>Field Duplicates:</u> One per 20 soil samples

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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 <sup>1</sup>	8260C	Groundwater	<u>Surrogates</u> 1,2-Dichloroethane-d4 4-Bromofluorobenzene Toluene-d8	<u>% Rec.</u> 74-132 77-124 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 <sup>2</sup>	8270D	Groundwater	<u>Surrogates</u> 2-Fluorophenol Phenol-d5 2,4,6-Tribromophenol Nitrobenzene-d5 2-Fluorobiphenyl Terphenyl-d14	<u>% Rec</u> 25-58 14-39 26-139 51-108 45-107 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
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

<sup>1</sup> 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.

<sup>2</sup> 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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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
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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 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 $\leq$ 20	<u>Field Duplicates:</u> One per 20 groundwater samples
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 $\leq$ 20	<u>Field Duplicates:</u> One per 20 groundwater samples

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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
PFAS	537 Modified	Groundwater	<u>Extracted Internal Standard (IDA): 25-150</u>  <u>Refer to Table 2B-I below for LCS &amp; 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.

Table 2B-I LCS & MS/MSD Accuracy Control Limits for PFAS			
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
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<b>Table 2C</b> <b>Laboratory Data Quality Objectives: Precision and Accuracy: Soil Vapor Samples</b>						
<b>Parameter</b>	<b>Method</b>	<b>Matrix</b>	<b>Accuracy Control Limits</b>	<b>Accuracy Frequency Requirements</b>	<b>Precision (RPD) Control Limits</b>	<b>Precision Frequency Requirements</b>
VOCs	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 Refer to SOP BR-AT-004, provided in Attachment A.						

<b>Table 2B-II</b> <b>Method Detection Limits (MDLs) and Reporting Limits (RLs) for PFAS</b>		
<b>Matrix</b>	<b>Soil</b>	<b>Groundwater</b>
<b>Analyte</b>	<b>MDL (ug/kg)</b>	<b>MDL (ng/L)</b>
Perfluorobutanoic acid (PFBA)	0.0240	2.0
Perfluoropentanoic acid (PFPeA)	0.0240	0.500
Perfluorohexanoic acid (PFHxA)	0.0190	0.500
Perfluoroheptanoic acid (PFHpA)	0.0240	0.500
Perfluorooctanoic acid (PFOA)	0.0220	0.500
Perfluorononanoic acid (PFNA)	0.0230	0.500
Perfluorodecanoic acid (PFDA)	0.0240	0.500
Perfluoroundecanoic acid (PFUnA)	0.0560	0.500
Perfluorododecanoic acid (PFDoA)	0.0230	0.500
Perfluorotridecanoic acid (PFTriA)	0.0210	0.500
Perfluorotetradecanoic acid (PFTeA)	0.0240	0.500
Perfluorobutanesulfonic acid (PFBS)	0.362	0.500
Perfluorohexanesulfonic acid (PFHxS)	0.0190	0.500
Perfluoroheptanesulfonic Acid (PFHpS)	0.0200	0.500
Perfluorooctanesulfonic acid (PFOS)	0.035	0.500
Perfluorodecanesulfonic acid (PFDS)	0.0210	0.500
Perfluorooctanesulfonamide (FOSA)	0.0210	0.500
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	0.0310	0.600
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	0.0220	0.500

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<b>Table 2B-II</b>		
<b>Method Detection Limits (MDLs) and Reporting Limits (RLs) for PFAS</b>		
<b>Matrix</b>	<b>Soil</b>	<b>Groundwater</b>
<b>Analyte</b>	<b>MDL (ug/kg)</b>	<b>MDL (ng/L)</b>
6:2 FTS	0.0490	2.0
8:2 FTS	0.0240	1.0
Notes: The laboratory SOP for PFAS analysis is included in Attachment A.		

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## **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 plus the 10 highest concentration tentatively identified compounds (TICs); TCL and NYSDEC CP-51-listed SVOCs plus the 20 highest concentration TICs; TAL metals and cyanide, TCL pesticides, TCL herbicides, PCBs and PFAS. Groundwater samples will also be analyzed for 1,4-dioxane (included as SVOC). Sub-slab vapor 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 for the locations within the 429 89th Street building and a Sonic rig will be utilized to collect samples in 5-foot long, 3.5-inch diameter polyethylene bags at the three exterior locations (TRC-SB-14, TRC-SB-15, and TRC-SB-21). A jackhammer and hand tools will be used to advance soil borings in the 8802 5th Avenue building. 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  $\pm 10$  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

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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. During purging, the purge flow rate will not exceed 0.200 liters per minute (L/min). 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 a 2-hour flow controller. Using a 0.05 L/min flow regulator, the sample collection time will be approximately 120 minutes.

### **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.

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**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 day per matrix (for soil and groundwater). 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.

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- 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.
- 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.

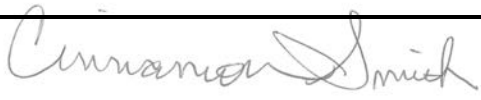

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**ATTACHMENT A**

Standard Operating Procedures – TRC and Eurofins



Title: <b>Groundwater Sampling</b>		Procedure Number: <b>ECR 009</b>	
		Revision Number: <b>2</b>	
		Effective Date: <b>November 2016</b>	
Authorization Signatures			
			
Technical Reviewer Cinnamon Smith	Date 11/14/16	ECR Practice Quality Coordinator Elizabeth Denly	Date 11/14/16

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## ATTACHMENTS

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Attachment B	Example Groundwater Field Data Records
Attachment C	SOP Fact Sheet
Attachment D	SOP Modifications for PFAS

## **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 [ $\mu\text{m}$ ]) 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

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## **1.4 Definitions**

<b>Bailer</b>	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.
<b>Borehole</b>	A hole drilled into the soil or bedrock using a drill rig or similar equipment.
<b>Dense Non-aqueous Phase Liquid (DNAPL)</b>	Separate-phase product that is denser than water and, therefore, sinks to the bottom of the water column.
<b>Depth To Water (DTW)</b>	The distance to the groundwater surface from an established measuring point.
<b>Drawdown</b>	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.
<b>FID</b>	An instrument that uses a flame to break down volatile organic compounds (VOCs) into ions that can be measured.
<b>Flow-Through Cell</b>	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.
<b>Flush Mount</b>	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.
<b>Light Non-aqueous Phase Liquid (LNAPL)</b>	Separate-phase product that is less dense than water and therefore floats on the surface of the water.

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<b>Monitoring Well</b>	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.
<b>PID</b>	An instrument that uses an ultraviolet light source to break down VOCs into ions that can be measured.
<b>Piezometer</b>	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.
<b>Potentiometric Surface</b>	A surface representing the hydraulic head of groundwater.
<b>Protective Casing</b>	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.
<b>Recharge Rate</b>	The rate at which groundwater returns to the water column in the well.
<b>Separate-Phase Product</b>	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.
<b>Static Water Level</b>	Level at which water resides in a well when the water level is at equilibrium with atmospheric pressure.
<b>Well Cover</b>	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.
<b>Well Filter Pack</b>	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.
<b>Well Plug/Expansion Plug</b>	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.

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<b>Well Riser</b>	Sections of blank (non-slotted) pipe that extend from the well screen to or above the ground surface.
<b>Well Screen</b>	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).



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- (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.

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**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.

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## **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:

$\pi$  = 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.]

$\text{cf}$  = conversion factor in gallons per cubic foot ( $\text{gal/ft}^3$ ) = 7.48  $\text{gal/ft}^3$ .

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

Well Inside Diameter (inches)	Volume ( $\text{gal/ft}$ )	Volume ( $\text{L/ft}$ )
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  $\text{gal/ft}$  or  $\text{L/ft}$

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:

- $\text{pH} \pm 0.1$  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.

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## **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.



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**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.

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## 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.

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#### **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*.

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

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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/](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><a href="http://www.epa.gov/region1/lab/qa/pdfs/EQASOP-GW001.pdf">http://www.epa.gov/region1/lab/qa/pdfs/EQASOP-GW001.pdf</a> (for low flow PDF)</p> <p><a href="http://www.epa.gov/region1/lab/qa/qualsys.html">http://www.epa.gov/region1/lab/qa/qualsys.html</a> (for EPA's Quality System Documents)</p>	<p>pH: <math>\pm 0.1</math> unit</p> <p>Specific Conductance: <math>\pm 3\%</math></p> <p>Temperature: <math>\pm 3\%</math></p> <p>Turbidity: <math>\pm 10\%</math> if <math>&gt; 5</math> NTUs; if three Turbidity values are <math>&lt; 5</math> NTU, consider the values as stabilized</p> <p>Dissolved Oxygen: <math>\pm 10\%</math> if <math>&gt; 0.5</math> mg/L, if three Dissolved Oxygen values are <math>&lt; 0.5</math> mg/L, consider the values as stabilized</p> <p>Oxidation/Reduction Potential: <math>\pm 10</math> 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><a href="http://www.epa.gov/region4/sesd/fbqstp/index.html">http://www.epa.gov/region4/sesd/fbqstp/index.html</a></p> <p>See Chemical Parameter Stabilization Criteria (section 3.2.1.1.2 of Groundwater Sampling SOP, revision 3/6/2013:</p> <p><a href="http://www.epa.gov/region4/sesd/fbqstp/Groundwater-Sampling.pdf">http://www.epa.gov/region4/sesd/fbqstp/Groundwater-Sampling.pdf</a></p>	<p>pH: <math>\pm 0.1</math> unit</p> <p>Specific Conductance: <math>\pm 5\%</math></p> <p>Temperature: Not used</p> <p>Turbidity: "Stabilized" (no criteria specified) if <math>&gt; 10</math> NTUs ; if three Turbidity values are <math>&lt; 10</math> NTUs, consider the values as stabilized</p> <p>Dissolved Oxygen (optional parameter): <math>\pm 0.2</math> mg/L or <math>\pm 10\%</math> 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><a href="http://www.epa.gov/superfund/remedytech/tsp/download/gw_sampling_guide.pdf">http://www.epa.gov/superfund/remedytech/tsp/download/gw_sampling_guide.pdf</a></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: <math>\pm 0.1</math> unit</p> <p>Specific Conductance: <math>\pm 3\%</math></p> <p>Temperature: Not used</p> <p>Turbidity: <math>\pm 10\%</math> if <math>&gt; 10</math> NTUs</p> <p>Dissolved Oxygen: <math>\pm 0.3</math> mg/L</p> <p>Oxidation/Reduction Potential: <math>\pm 10</math> 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><a href="http://www.adem.state.al.us/MoreInfo/pubs/AEIRGInvestigation.pdf">http://www.adem.state.al.us/MoreInfo/pubs/AEIRGInvestigation.pdf</a></p>	<p>pH: <math>\pm 0.1</math> unit</p> <p>Specific Conductance: <math>\pm 10\%</math></p> <p>Temperature: "Constant" (no criteria specified)</p> <p>Turbidity: Stabilized (no criteria specified), or <math>&lt; 10</math> 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  <a href="http://www.in.gov/idem/files/remediation_tech_guidance_micro-purge.pdf">http://www.in.gov/idem/files/remediation_tech_guidance_micro-purge.pdf</a></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: <math>\pm 0.1</math> unit  Specific Conductance: <math>\pm 3\%</math>  Temperature: <math>\pm 3\%</math>  Turbidity: <math>\pm 10\%</math>  Dissolved Oxygen: <math>\pm 10\%</math>  Oxidation/Reduction Potential: <math>\pm 10</math> millivolts (document says microvolts, but that may be an error)</p>
Michigan	<p>MDEQ Part 201 Op Memo 2, Attachment 5  <a href="http://www.michigan.gov/documents/deq/deq-rrd-OpMemo_2_Attachment5_249853_7.pdf">http://www.michigan.gov/documents/deq/deq-rrd-OpMemo_2_Attachment5_249853_7.pdf</a></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  <a href="http://www.state.nj.us/dep/srp/guidance/fspm/">http://www.state.nj.us/dep/srp/guidance/fspm/</a></p>	<p>pH: <math>\pm 0.1</math> unit  Specific Conductance: <math>\pm 3\%</math>  Temperature: <math>\pm 3\%</math>  Dissolved Oxygen: <math>\pm 10\%</math>  Turbidity: <math>\pm 10\%</math> for values greater than 1 NTU  ORP/Eh: <math>\pm 10</math> millivolts</p>
Ohio	<p>Ohio EPA SOPs:  <a href="http://www.epa.state.oh.us/portals/30/rules/FSOPs.pdf">http://www.epa.state.oh.us/portals/30/rules/FSOPs.pdf</a></p> <p>See Purging Stabilization Criteria (SOP 2.2.4, dated January 2, 2007, review in progress)</p>	<p>pH: <math>\pm 0.1</math> unit  Specific Conductance: <math>\pm 3\%</math>  Temperature: No criteria specified  Turbidity: Below 10 NTUs ideal; <math>\pm 10\%</math> if greater than 10 NTUs  Dissolved Oxygen: <math>\pm 0.3</math> mg/L  Oxidation/Reduction Potential: <math>\pm 10</math> millivolts</p>
<b>This table was last updated in July 2014.</b>		

## **Attachment B:**

# **Example Groundwater Field Data Records**



 <b>Groundwater Field Data Record</b>		Project: _____ Project No.: _____		Date/Time: _____		Sheet ____ of ____																									
		TRC Personnel: _____		Well ID: _____																											
<b>WELL INTEGRITY</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">YES</th> <th style="text-align: center;">NO</th> </tr> </thead> <tbody> <tr> <td>Protect. Casing Secure</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>Concrete Collar Intact</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>PVC Stick-up Intact</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>Well Cap Present</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>Security Lock Present</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><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"/>	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 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"/>																													
Sampling Equipment: _____ Flow-thru Cell Volume: _____ <b>PID SCREENING MEAS.</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Background</td> <td style="width: 50%;"></td> </tr> <tr> <td>Well Mouth</td> <td></td> </tr> </table>		Background		Well Mouth		<b>WELL MATERIAL</b> <input type="checkbox"/> PVC <input type="checkbox"/> SS Other: _____																									
Background																															
Well Mouth																															
<b>FIELD WATER QUALITY MEASUREMENTS (record at appropriate intervals)</b>																															
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							<b>Stabilization Criteria* (3 consecutive readings)</b> - 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)																															
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Bladder Pump	<input type="checkbox"/>	<input type="checkbox"/>																													
Bailer	<input type="checkbox"/>	<input type="checkbox"/>																													
Other: _____	<input type="checkbox"/>	<input type="checkbox"/>																													
Analytical Parameter	Filtered (Y/N)	Preservation	# Bottles	Size/Type Bottles	Time Collected	QC	Sample #																								


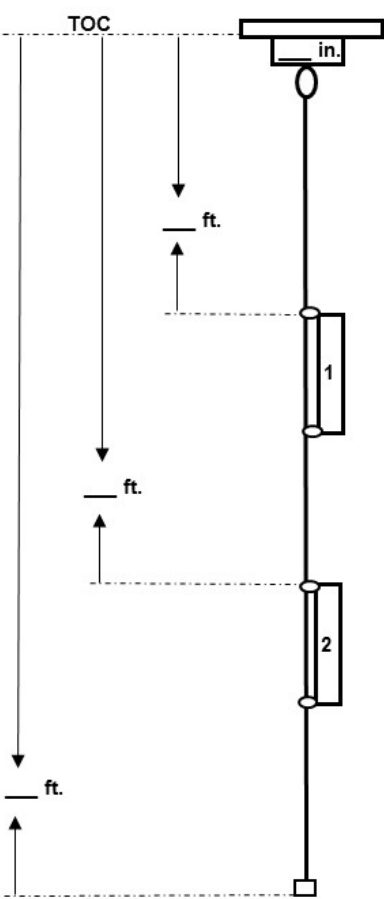
\* Consult the applicable regulatory guidance for the specific criteria.

Signed: \_\_\_\_\_

Rev: April 2014



**Groundwater Sampling**  
Procedure No: ECR 009  
***TRC Controlled Document***

 <b>Groundwater Sampling Record for Organics</b> (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> <p>PDB #2 Length: ____ in.</p> </div> </div> <div style="flex: 1; margin-left: 20px;"> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">           Sample ID: _____            Sample Time: _____            Evidence of algae, iron or other coatings?: _____         </td> </tr> </table>   <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">           Sample ID: _____            Sample Time: _____            Evidence of algae, iron or other coatings?: _____         </td> </tr> </table> </div> </div> <div style="margin-top: 10px;">       Measured well depth during tether installation: ____ ft.     </div>				Sample ID: _____ Sample Time: _____ Evidence of algae, iron or other coatings?: _____	Sample ID: _____ Sample Time: _____ Evidence of algae, iron or other coatings?: _____		
Sample ID: _____ Sample Time: _____ Evidence of algae, iron or other coatings?: _____							
Sample ID: _____ Sample Time: _____ Evidence of algae, iron or other coatings?: _____							
Field Notes:							

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

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

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| <ul style="list-style-type: none"> <li>• Prepare/update the site-specific HASP; make sure the field team is familiar with the most recent version.</li> <li>• 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"> <li>○ Communication procedures;</li> <li>○ Sampling order and designation;</li> <li>○ Collection and sample method;</li> <li>○ Analytical parameters, holding times and turn-around times;</li> <li>○ Laboratory (contact/shipping info, COC, billing references);</li> <li>○ Purge water management (Drums? Discharge to ground?);</li> <li>○ QC sample collection; and</li> <li>○ Decontamination procedures.</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Verify that monitoring wells will be accessible and/or coordinate to have a site contact available to assist.</li> <li>• Make sure that monitoring well sample designations and QC sample designations/frequency are understood.</li> <li>• 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.</li> <li>• Review sample bottle order for accuracy and completeness and damaged bottles.</li> <li>• Discuss specific documentation and containerization requirements for investigation-derived waste disposal with the Project Manager</li> </ul> |
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### 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"> <li>• Decontaminate pump.</li> <li>• Take water level measurements prior to pump installation.</li> <li>• Connect sampling tubing to pump outlet and lower to sample depth; <b>ALWAYS USE ROPE TO SECURE PUMP TO SURFACE.</b></li> <li>• 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).</li> <li>• For wells with screened or open borehole intervals greater than 10 feet in length, sampling of multiple intervals may be required.</li> <li>• 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</li> </ul> | <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"> <li>• Be careful not to let the pump hit the bottom of the well.</li> <li>• 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.</li> <li>• 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.</li> </ul> |
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### SAMPLING PROCEDURES: MULTIPLE-VOLUME PURGING

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| <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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:<br/> <math display="block">\text{Well Volume (V)} = \pi r^2 h</math> </li> <li>• For volumetric purging, an adequate purge is typically achieved when 3 to 5 well volumes have been removed.</li> </ul> | <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• In other cases, where specified in the project-specific work plan, stabilization of field parameters must be documented prior to sample collection.</li> <li>• 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.</li> <li>• 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.</li> </ul> |
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### 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.

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### POST-PURGE GROUNDWATER SAMPLE COLLECTION

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| <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• Collect groundwater samples in the following order:               <ul style="list-style-type: none"> <li>○ VOCs;</li> <li>○ SVOCs;</li> <li>○ Other organic parameters;</li> <li>○ Unfiltered inorganic constituents; and</li> <li>○ Filtered inorganic constituents.</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• Make sure all sample bottles are appropriately labeled.</li> <li>• 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.</li> <li>• Decontaminate non-disposable sampling equipment between uses.</li> </ul> |
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### PASSIVE SAMPLING

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| <ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> </ul> | <ul style="list-style-type: none"> <li>• 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).</li> <li>• 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.</li> <li>• Detach the passive sampler from the tether.</li> <li>• 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.</li> </ul> |
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## 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.

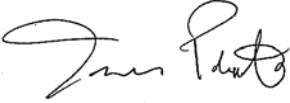

<b>PFAS Sampling Protocols</b>	
<b>SOP Section Number</b>	<b>Modifications to SOP</b>
1.3	<ul style="list-style-type: none"> <li>Do not use equipment utilizing Teflon® or low density polyethylene (LDPE)<sup>1</sup> during sample handling or mobilization/demobilization. This includes bailers, tubing, 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.</li> <li>Passive diffusion bags (PDBs) should not be used due to the presence of LDPE material in PDBs.</li> <li>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.</li> <li>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.</li> <li>Do not use aluminum foil.</li> <li>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.</li> <li>Do not use Post-It Notes during sample handling or mobilization/demobilization.</li> <li>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.</li> </ul>
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"> <li>Tyvek® suits should not be worn during PFAS sampling events. Cotton coveralls may be worn.</li> <li>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.</li> <li>Stain resistant clothing should not be worn.</li> <li>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.</li> <li>Personnel involved with sample collection and handling should wear</li> </ul>

<b>PFAS Sampling Protocols</b>	
<b>SOP Section Number</b>	<b>Modifications to SOP</b>
	<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"> <li>• Wash hands with Alconox or Liquinox and deionized water after leaving vehicle before setting up to sample a well.</li> </ul>
1.6.1	<ul style="list-style-type: none"> <li>• Avoid wearing clothing laundered with fabric softeners.</li> <li>• Avoid wearing new clothing (recommended 6 washings since purchase). Clothing made of cotton is preferred.</li> <li>• Avoid using cosmetics, moisturizers, hand creams, or other related products as part of cleaning/showering on the day of sampling.</li> <li>• Avoid using sunscreens or insect repellants that are not natural or chemical free.</li> </ul>
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:

<sup>1</sup> – 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.



Title: <b>Equipment Decontamination</b>		Procedure Number: <b>ECR 010</b>	
		Revision Number: <b>1</b>	
		Effective Date: <b>December 2016</b>	
Authorization Signatures			
			
Technical Reviewer James Peronto	Date 12/15/16	ECR Practice Quality Coordinator Elizabeth Denly	Date 12/15/16

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## ATTACHMENTS

Attachment A	SOP Fact Sheet
Attachment B	SOP Modifications for PFAS

## **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"> <li>Field book</li> <li>Appropriate PPE</li> <li>Site-specific HASP</li> <li>Alconox®, Liquinox® or other nonphosphate concentrated laboratory-grade soap</li> <li>Simple Green® or other nontoxic biodegradable cleaner</li> <li>Deionized, distilled, or organic-free water, as appropriate</li> <li>Potable water (or water containers if potable water source on site or nearby)</li> <li>Pump or pressure sprayer</li> <li>Squeeze bottles filled with appropriate decontamination chemicals (e.g., organic solvents, nitric acid)</li> <li>Containers, such as buckets or wash basins (type and number is dependent on the procedure)</li> <li>Scrub brushes</li> <li>Aluminum foil</li> <li>Polyethylene sheeting</li> </ul>	
OFFICE	
<ul style="list-style-type: none"> <li>Prepare/update the site-specific HASP; make sure the field team is familiar with the latest version.</li> <li>Review site-specific sampling plan/QAPP for decontamination procedures and procedures for management of investigation-derived waste (IDW) (e.g., used decontamination solutions).</li> <li>Confirm all required decontamination supplies are in stock or order as needed.</li> </ul>	
ON-SITE	
<ul style="list-style-type: none"> <li>Verify project HASP including safety data sheets for decontamination chemicals used on site.</li> <li>Conduct daily Health &amp; Safety tailgate meetings, as appropriate.</li> <li>Establish a designated equipment and personnel decontamination area.</li> <li>Provide for the proper collection and management of all IDW.</li> <li>Verify that appropriate PPE is worn by all site personnel (including subcontractors) and the work area is safe.</li> </ul>	
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. <b>A more simplified procedure for decontamination of measuring equipment is presented in the SOP.</b> 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"> <li>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.</li> <li>Fill the first container with potable water. Add sufficient nonphosphate concentrated laboratory-grade soap to cause suds to form in the container.</li> <li>Brush any visible dirt off of the sampling equipment before getting equipment wet.</li> <li>Using a clean, coarse scrub brush, submerge and wash the sampling equipment in the soap solution in the first container.</li> </ol>	

## 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.

<b>PFAS Equipment Decontamination Protocols</b>	
<b>SOP Section Number</b>	<b>Modifications to SOP</b>
1.3	<ul style="list-style-type: none"> <li>• Use only Alconox® or Liquinox® soap; do not use Decon 90.</li> <li>• Use new plastic buckets for wash and rinse water.</li> <li>• Ensure that PFAS-free water is used during the decontamination procedure.</li> <li>• Do not use aluminum foil.</li> </ul>
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"> <li>• Tyvek® suits should not be worn. Cotton coveralls may be worn.</li> <li>• 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.</li> <li>• 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.</li> <li>• 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.</li> <li>• Do not store on or cover equipment with aluminum foil after decontamination. Use of polyethylene sheeting is acceptable.</li> <li>• Avoid wearing clothing laundered with fabric softeners.</li> <li>• Avoid wearing new clothing (recommended six washings since purchase). Clothing made of cotton is preferred.</li> <li>• Avoid using cosmetics, moisturizers, hand creams, or other related products as part of cleaning/showering the morning of sampling and decontamination field work.</li> </ul>
2.2	<ul style="list-style-type: none"> <li>• New nylon or metal bristle brushes should be used for mechanical cleaning methods.</li> <li>• If high-pressure water is used, it must be tested prior to use for presence of PFAS.</li> </ul>
2.3	<ul style="list-style-type: none"> <li>• Ensure that PFAS-free water is used during the decontamination procedure.</li> </ul>
2.4	<ul style="list-style-type: none"> <li>• Ensure that PFAS-free water is used during the decontamination procedure.</li> </ul>

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Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b>	Document users: <b>5_EUUSLA_PFAS_Manager,  6_EUUSLA_PFAS_Analyst,  6_EUUSLA_PFAS_Data_Reviewers,  6_EUUSLA_PFAS_Management_Team,  6_EUUSLA_PFAS_Sample_Prep</b>	Responsible: <b>5_EUUSLA_PFAS_Manager</b>

## PROPRIETARY AND COMPANY CONFIDENTIAL

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## Revision Log

	<b>Revision:</b> <u>10</u>	<b>Effective date:</b> <u>This version</u>
<b>Section</b>	<b>Justification</b>	<b>Changes</b>
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Scope	Corrected typographical error	Removed perfluoroundecanoic acid from the N-ethylperfluoro-1-octanesulfonamidoacetic acid analyte name field
Apparatus and Equipment	Reflect current protocol	Added AB Sciex 5500/5500 plus. removed all references to glass syringes
Reagents and Standards	Reflect current protocol	Added preparation of the 20 mM ammonium acetate solution in 0.5% Milli-Q water/methanol. Added purchasing information
Calibration	Reflect current protocol	Removed reference to an MDL standard. Low point of the calibration curve is at the MDL.
Calculations	Enhancement	Added ion ratio calculation added requirement for quad fits.





	Always check on-line for validity.	Level: 
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Procedure/Attachments	Enhancement	
		Added prep instructions using attachments for alternate matrices see attachments 5-10. Added criteria for RT and ion ration. Added <a href="#">Attachment 11</a> to note special requirements for samples from MN. added reference to the document throughout the SOP.
Procedure B.12	Reflect current protocol	Removed verbiage related to the MDL standard.
Procedure B.15	Reflect current protocol	Updated sample extract dilution protocol
<a href="#">Attachment 2</a> and Procedure.	Enhancement	Attachment: corrected PFOS(2) transition mass to be 499-99. add 2nd transition masses for genx, and other compounds. Procedure: update compound list that lack 2nd trans to be only PFBA ,PFPeA, PFOSA, NMePFOSAE, NMEPFOSA, NETPFOSAE, and NETPFOSA.

Revision	9	Effective Date:	11-NOV-2019
Section	Justification	Changes	
Revision Log	Formatting requirement	Removed revision logs up to the previous version	
Attachments	Correction	Corrected Headers of attachments to match the attachment numbers in the body of the document. add references to attachment 2 and 3 within the document.	
Procedure	Enhancement	Added attachment 4 and verbiage about salt/anion(acid) concentrations	

## Reference

1. US EPA Method 537, Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LCMSMS), Version 1.1, September 2009.
2. Standard Test Method for Determination of Perfluorinated Compounds in Soil by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS), ASTM Method D7968, 2014.
3. Method for Trace Level Analysis of C8, C9, C10, C11, and C13 Perfluorocarbon Carboxylic Acids in Water. Karen Risha, John Flaherty, Roice Wille, Warren Buck, Francesco Morandi, and Tsuguhide Isemura. Anal. Chem. 2005, 77, 1503-1508.
4. Testing Methods for Evaluation Solid Wastes, SW-846 Method 8321B, Solvent Extractable Non-Volatile Compounds by High Performance Liquid Chromatography/Thermospray Mass Spectrometry or Ultraviolet Detection, Rev 2, January 1998.
5. Determinative Chromatographic Separations, SW-846, Method 8000D, July 2014.
6. *Chemical Hygiene Plan*, current version.

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## Cross Reference



Document	Document Title
<a href="#">T-PEST-WI9847</a>	Common Equations Used During Chromatographic Analyses
<a href="#">T-PFAS-WI13881</a>	Standards Management in the PFAS Laboratory
<a href="#">QA-SOP11178</a>	Demonstrations of Capability
<a href="#">QA-SOP11892</a>	Determining Method Detection Limits and Limits of Quantitation

## Scope

This method is applicable for the determination of selected perfluorinated alkyl substances (PFAS) in soil and solid samples. The compounds analyzed in this method are listed in the table below.

The most current MDLs and LOQs are listed in the LIMS.

Analyte	Acronym	CAS#
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorododecanoic acid	PFDODA	307-55-1
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorotridecanoic acid	PFTTrDA	72629-94-8
Perfluoroundecanoic acid	PFUnDA	2058-94-8
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
8:2 - Fluorotelomersulfonic acid	8:2FTS	39108-34-4
N-methylperfluoro-1-octanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethylperfluoro-1-octanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
4:2-Fluorotelomersulfonic acid	4:2-FTS	757124-72-4
Perfluoropentanesulfonic acid	PFPeS	2706-91-4

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6:2-Fluorotelomersulfonic acid	6:2-FTS	27619-97-2
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
10:2-Fluorotelomersulfonic acid	10:2-FTS	120226-60-0
Perfluorododecanesulfonic acid	PFDsDS	79780-39-5
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
Perfluorooctanesulfonamide	PFOSA	754-91-6
2-(N-methylperfluoro-1-octanesulfonamido)-ethanol	NMePFOSAE	24448-09-7
N-methylperfluoro-1-octanesulfonamide	NMePFOSA	31506-32-8
2-(N-ethylperfluoro-1-octanesulfonamido)-ethanol	NEtPFOSAE	1691-99-2
N-ethylperfluoro-1-octanesulfonamide	NEtPFOSA	4151-50-2
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid	HFPODA	13252-13-6
4,8-dioxa-3H-Perfluorononanoic acid	DONA **	919005-14-4 *
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1 *
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9 *

\* = CAS number for the free acid form of the analyte

\*\* = The acronym for the free acid form of the analyte



## Basic Principles

A soil sample is fortified with isotopically-labeled extraction standards, and extracted for an hour with PROPRIETARY using ultrasonic extraction. The sample extracts are vortexed and centrifuged. A 2.0 mL portion of supernatant is transferred and concentrated with nitrogen in a heated water bath and then reconstituted to 1.0 ml with methanol. Isotopically-labeled injection internal standards are added to the sample extract and it is analyzed by LC/MS/MS operated in negative electrospray ionization (ESI) mode for detection and quantification of the analytes. Quantitative analysis is performed using isotope dilution.

## Reference Modifications

EPA Method 537 is written specifically for the analysis of drinking water samples. Modifications are made to accommodate the preparation of soil samples which are not addressed in EPA 537 Version 1.1. In addition, the following modifications have been made.



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1. A labeled isotopic analog is spiked into samples for all compounds where an isotopic analog is commercially available. These isotopic compounds are referred to as extraction standards. For those compounds, an isotope dilution calibration model is used. Where labeled isotopes are not available, an internal standard calibration model using the extraction standards is used.
2. Prior to instrumental analysis, separate but similar isotopic analogs are added to the sample extract. Using an internal standard calibration model these injection standards are used to calculate recoveries of the extraction standards.
3. Field reagent blanks are not processed as listed in EPA 537 Version 1.1 section 8.3
4. Spike concentrations are not rotated between low, medium and high levels.

MDL studies and IDOCs have been performed to validate method performance.

## Interferences

Compounds which have similar structures to the compounds of interest and similar molecular weights would potentially interfere. Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The analytes in this method can also be found in many common laboratory supplies and equipment, such as polytetrafluoroethylene (PTFE) products, LC solvent lines, methanol, aluminum foil, etc. A laboratory blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.

## Precaution to Minimize Method Interference



1. PROPRIETARY
2. PROPRIETARY
3. PFAS standards, extracts and samples should not come in contact with any glass containers as these analytes can potentially adsorb to glass surfaces. PFAS analytes and internal standards commercially purchased in glass ampules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be stored in polypropylene containers.

## Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. PFOA has been described as "likely to be carcinogenic to humans". Each chemical should be treated as a potential health hazard and exposure to these chemicals should be minimized.

Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves. Gloves, lab coats, and safety glasses should be worn when preparing standards and handling samples. Avoid inhaling solvents and chemicals and getting them on the skin.

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Wear gloves when handling neat materials. When working with acids and bases, take care not to come in contact and to wipe any spills. Always add acid to water when preparing reagents containing concentrated acids.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. All solvent waste and extracts are collected in approved solvent waste containers in the laboratory and subsequently emptied by personnel trained in hazardous waste disposal into the lab-wide disposal facility. HPLC vials are disposed of in the lab container for waste vials, and subsequently lab packed. Any solid waste material (disposable pipettes and broken glassware, etc.) may be disposed of in the normal solid waste collection containers.

## Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC).

Each chemist performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Also, several batches of sample extractions must be performed under the direct observation of another experienced chemist to assure the trainee is capable of independent preparation. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

Each LC/MS/MS analyst must work with an experienced employee for a period of time until they can independently calibrate the LC/MS/MS, review and process data, and perform maintenance procedures. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and DOC consist of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meets the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

See [QA-SOP11178](#) for additional information on IDOC and DOC.

## Sample Collection, Preservation, and Handling

### A. Sample Collection

The samples are collected in 250-mL polyethylene bottles with polyethylene screw caps. Keep the sample sealed from time of collection until extraction.



**NOTE:** PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

### B. Sample Storage and Shipment

1. Samples must be chilled during shipment and must not exceed 10°C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10°C when the samples are received at the laboratory.

2. Samples stored in the lab must be held at a temperature of 0° to 6°C, not frozen, until extraction.



3. Samples must be extracted within 28 days of collection. Extracts must be analyzed within 28 days after extraction. Extracts are stored at room temperature.

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Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b>	Document users: <b>5_EUUSLA_PFAS_Manager,  6_EUUSLA_PFAS_Analyst,  6_EUUSLA_PFAS_Data_Reviewers,  6_EUUSLA_PFAS_Management_Team,  6_EUUSLA_PFAS_Sample_Prep</b>	Responsible: <b>5_EUUSLA_PFAS_Manager</b>

## Apparatus and Equipment

### A. Apparatus

1. Centrifuge tubes – 15-mL conical polypropylene with polypropylene screw caps; Fisher, Cat. No. 05-539-5 or equivalent
2. Centrifuge tubes - 50-mL conical, polypropylene with polypropylene screw caps; Fisher, Cat. No. 06-443-21, or equivalent.
3. 10-mL polypropylene volumetric flask, Class A – Fisher Scientific, Cat. No. S02288 or equivalent.
4. HPDE bottles for extraction fluid storage: L; Environmental Sampling Supply, Cat. No. 1000-1902-PC
5. Auto-dispenser/Pump: Dispensette S Analog bottle-top dispenser, 5-50mL; Fisher Cat. No. 13-689-017.
6. Analytical Balance – Capable of weighing to 0.0001 g
7. Top-Loading Balance – Capable of weighing to 0.01 g
8. Centrifuge – “Q-Sep 3000”; Restek Corp. Cat. No. 26230 or equivalent, capable of minimum rotational speed of 3000 rpm.
9. Disposable polyethylene pipette – Fisher Scientific, Cat. No. S30467-1 or equivalent.
10. Auto Pipettes – Eppendorf; capable of accurately dispensing 10- to 1000-µL. FisherScientific cat # 14-287-150, or equivalent.
11. Polypropylene pipette tips: 0-200 µl. Fisher Cat. No. 02-681-135
12. Polypropylene pipette tips: 101-1000 µl. Fisher, Cat. No. 02-707-508
13. Pipettes – Disposable transfer. Fisher, Cat. No. 13-711-7M
14. Disposable polypropylene spatulas – VWR; Cat. No. 80081-190.
15. Vortex mixer, variable speed, Fisher Scientific or equivalent
16. PROPRIETARY
17. PROPRIETARY
18. Reagent Water Purification System: Capable of producing ultrapure “Type 1/Milli-Q”-grade water from in-house deionized water system. Millipore SAS; Cat. No. FTPF08831.
19. PROPRIETARY
20. Agilent 9mm vial kit pack, catalog number 5190-2278, or equivalent
21. Wooden Tongue Depressors - Fisher; Cat. # 11-700-555, or equivalent.

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## B. Equipment

### 1. AB Sciex Triple Quad 4500/5500/5500 Plus Turbo V Ion Source

ExionLC Controller  
ExionLC AC Pump  
ExionLC AC Autosampler  
Exion AC Column Oven  
Data system –Analyst 1.6.3

### 2. HPLC columns

PROPRIETARY

## Reagents and Standards

All solvents, acids, and bases are stored in glass bottles in flammable proof cabinets or pressure resistant steel drums. Solvents, acids, and bases are stored at ambient temperature for up to 1 year. All non-solvents are stored according to manufacturer's storage conditions.

### A. Reagents:

PROPRIETARY

### B. Standards: See SOP [T-PFAS-WI13881](#).

## Calibration

### A. Initial Calibration

1. A minimum of five calibration standards are required. In general, Cal1, Cal2, Cal3, Cal4, Cal5, Cal6, and Cal7 are included in the initial calibration. The calibration standards contain the branched isomers for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. S/N ratio must be  $\geq 10:1$  for all ions used for quantification.



2. Analyze a Cal3 level standard that contains linear and branch chained isomers of PFOA. The analysis of this standard is used to demonstrate where the branch chained isomers elute and not included in the calibration curve. This will assist the chemist in identifying and properly integrating this compound in samples.

3. Fit the curve with a linear through zero or a linear with a concentration weighing factor of  $1/x$  or quadratic regression with a concentration weighing factor  $1/x^2$ . A minimum of six calibration standards must be analyzed to use a quadratic fit.

NOTE: The concentrations referenced for the sulfonate salts (for example PFBS, PFHxS and PFOS) have already been corrected to the acid form by the standards supplier as noted in the example Certificate of Analysis (CofA). See [Attachment 4](#).

4. Peak asymmetry factor must be calculated with each ICAL. The factor for the first two eluting peaks in the CAL5 standard must fall in the range of 0.8-1.5

5. Isotopically-labeled compounds are not available for PFPeS, PFHpS, PFNS, PFDS, PFDoS, 10:2-FTS, PFTrDA, PFHxDA, PFODA, DONA, 9Cl-PF3ONS, and 11Cl-PF3Ouds. See below for referenced extraction

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Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b>	Document users: <b>5_EUUSLA_PFAS_Manager,          6_EUUSLA_PFAS_Analyst,          6_EUUSLA_PFAS_Data_Reviewers,          6_EUUSLA_PFAS_Management_Team,          6_EUUSLA_PFAS_Sample_Prep</b>	Responsible: <b>5_EUUSLA_PFAS_Manager</b>

standards. See [Attachment 3](#) for additional information about compound relationships.

Compound	Extraction Standard
10:2-FTS	13C2-8:2-FTS
PFTTrDA	13C2-PFDoDA
PFHxDA	13C2-PFTeDA
PFODA	
PFPeS	13C3-PFBS
PFHpS	13C3-PFHxS
DONA	13C4-PFHpA
PFNS	13C8-PFOS
PFDS	
PFDoS	
9CI-PF3ONS	
11CI-PF3OUdS	

#### 6. Initial calibration acceptance criteria

**Note:** See [Attachment 11](#) for requirements for samples from the state of Minnesota.

a. When each calibration point, except the lowest point (Cal1), is calculated back against the curve, the back calculated concentration should be within  $\pm 30\%$  of its true value. The lowest calibration point (Cal1) should calculate to be within  $\pm 50\%$  of its true value.

b. The  $R^2$  value for each calibration curve must be  $\geq 0.99$  for each analyte.



c. If the criteria are not met, the source of the problem should be determined and corrected. If the criteria is not met, instrument maintenance and calibration may be required. Situations may exist where the initial calibration can be used. In those cases, the data will be reported with a qualifying comment.

#### 7. Initial Calibration Verification (ICV)

A check standard prepared from a second source (ICV) is injected to confirm the validity of the calibration curve/standard. If a second source is not available, a separate preparation from the same stock may be used. The calculated amount for each analyte must be within  $\pm 30\%$  of the true value. If this criteria is not met, re-inject or remake the standard. If the criteria is still not met, recalibration is necessary. Instrument maintenance may be needed prior to recalibrating.

#### B. Continuing calibration

**Note:** See [Attachment 11](#) for requirements for samples from the state of Minnesota.

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continuing calibration verification (CCV) standard every ten samples and at the end of the analysis sequence.

a. The CCV run after the initial calibration must be at the CAL3 level.

b. Subsequent CCV standards should alternate between the low, mid and high levels of the calibration curve.

## 2. Acceptance criteria

a. The calculated amount for each compound (native and extraction standard) in the CCV standard must be within  $\pm 30\%$  of the true value. Samples that are not bracketed by acceptable CCV analyses must be reanalyzed. The exception to this would be if the CCV recoveries are high, indicating increased sensitivity, and there are no positive detections in the associated samples, the data may be reported with a qualifying comment. If two consecutive CCVs fail criteria for target analytes, two passing CCVs must be analyzed or the source of the problem determined and the system recalibrated before continuing sample analysis.

b. The absolute areas of the injection internal standards should be within 50-150% of the average areas measured during the initial calibration.

## Procedure

### A. Sample preparation

NOTE: Prior to weighing out samples, thoroughly mix each sample using a wooden tongue depressor to ensure a homogeneous sample matrix.

See the following attachments for alternate matrix preparation instructions.

*Attachment 5* - PROPRIETARY  
*Attachment 6* - PROPRIETARY  
*Attachment 7* - PROPRIETARY  
*Attachment 8* - PROPRIETARY  
*Attachment 9* - PROPRIETARY  
*Attachment 10* - PROPRIETARY

1. On a calibrated, top-loading balance, accurately weigh  $1.0\text{g} \pm 0.10\text{g}$  of solid sample into a tared, labeled 15-mL centrifuge tube using a disposable polypropylene spatula. Record sample weight on sample batchlog and in the prep entry system.

2. For each batch - maximum 20 samples - include the following quality control samples:

a. Method Blank: Weigh  $1.0\text{g} \pm 0.10\text{g}$  of sand.



b. LCS/LCSD: Fortify  $1.0\text{g} \pm 0.10\text{g}$  of sand with 40  $\mu\text{L}$  of Native Spiking Solution (MSMODSX).

c. Matrix Spike (MS): Fortify  $1.0\text{g} \pm 0.10\text{g}$  of sample as specified in sample preparation log with 40  $\mu\text{L}$  of Native Spiking Solution (MSMODSX).

3. Add 50  $\mu\text{L}$  working labeled extraction surrogate solution to each sample/QC tube.

4. Through 11. - PROPRIETARY CONTENT



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12. Transfer 400 µL of the final extract to labeled auto-sampler vials with polypropylene insert. Add 20 µl of labeled internal standard spike and cap and vortex the auto-sampler vial. Samples are now ready for analysis.

13. Cap the centrifuge tube. Store the remaining centrifuged extracts at room temperature for dilution or reinjection if needed.

## B. LC/MS/MS Analysis

### 1. Mass Calibration and Tuning

a. At instrument set up and installation and after the performance of major maintenance, calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. The entire mass range must be calibrated.

b. When masses fall outside of the  $\pm 0.5$  amu of the true value, the instrument must be retuned using PPG according to the manufacturer's specifications. Mass assignments of the tuning standard must be within 0.5 amu of the true value. Refer to the instrument manufacturer's instructions for tuning and conditions. These values are stored in the tune file for future reference.

2. The mass spectral acquisition rate must include a minimum of 10 spectra scans across each chromatographic peak.

See the AB Sciex 4500/5500/5500 Plus Acquisition, Quantitation, Gradient, and detector condition files for the most up to date chromatographic conditions. Modifications to these conditions can be made at the discretion of the analyst to improve resolution or the chromatographic process.

3. Acquisition method: PROPRIETARY Mass Transitions: See [Attachment 2](#).



4. Load sample vials containing standards, quality control samples, and sample extracts into autosampler tray. Allow the instrument adequate time to equilibrate to ensure the mass spec and LC have reached operating conditions (approximately 5 minutes) before the first injection. Analyze several solvent blanks to ensure the instrument is clean prior to sample acquisition.

5. After the initial calibration and when analyzing samples within the same tune, inject an instrument blank, followed by the ICV, Linear branched (L/B) standard, closing Cal3 level CCV, extraction batch QC, and samples. Bracket each set of ten samples with a CCV standard, alternating between the CAL2, CAL3, and CAL4 levels.

6. After injections are completed, check all CCV recoveries and absolute areas to make sure they are within method control limits. See Calibration section B.2 for acceptance criteria. Process each chromatogram and closely evaluate all integrations, baseline anomalies, and retention time differences. If manual integrations are performed, they must be documented and a reason given for the change in integrations. The manual integrations are documented during data processing and all original integrations are reported at the end of the sample PDF file with the reason for manual integration clearly listed.

7. Quantitate results for the extraction blank. No target analytes at or above the reporting limit may be found in the extraction blank for acceptable batch results. If a target analyte is detected in the extraction blank but not detected in the sample, the data is reported. If a target analyte is detected in the method blank at a concentration greater than the reporting limit and also in the sample, the sample must be re-extracted. If the target analyte in the sample is detected at a concentration greater than 10 times the amount detected in the method blank, the data is reported.



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by comparing concentrations observed to the true values.

a. LCS, MS, extraction standard recoveries and RPDs are calculated and compared to the limits stored on the LIMS. See [Attachment 11](#) for requirements for samples from the state of Minnesota.

b. If LCS and/or LCSD recoveries are acceptable, proceed to sample quantitation.

c. If LCS recoveries are above the QC acceptance criteria, and there are no detections for the compound(s) in the associated sample(s), the data may be reported with a qualifying comment. In all other cases, the samples associated with the LCS must be reextracted.

d. If MS/MSD recoveries are outside QC acceptance criteria, the associated data will be flagged or noted in the comments section of the report.

9. Isotopically labeled extraction standards are added to all samples, extraction blank, LCS/LCSD, and MS/MSD prior to extraction. The recovery of the extraction standards should be within QC acceptance criteria. If the extraction standard recovery(ies) is/are outside the QC limit(s), consult a supervisor to determine the appropriate course of action based on batch and sample results.

10. Isotopically labeled injection standards are added to each QC and field sample extract prior to analysis. The absolute areas of the injection standards should be within 50-150% of the average areas measured during the initial calibration. If the internal standards are recovered outside 50-150%, consult a supervisor to determine the appropriate course of action based on batch and sample results. See [Attachment 11](#) for requirements for samples from the state of Minnesota.

11. Compare the retention times of all of the analytes, surrogates and internal standards to the retention time from the initial calibration. The retention times should not vary from the expected retention time by more than

a. 0.4 minutes for isotopically labeled compounds

b. 0.1 minutes from their analog for native compounds with an exact isotopically-labeled compound



c. 0.4 minutes from their assigned analog for native compounds without an exact isotopically-labeled compound.

If the retention time is outside of the criteria, the compound is considered a false positive unless it is a compound with branched isomers. Compounds with branched isomers can vary in intensity of the individual isomers that are used for reporting and must be reviewed and compared to the preceding CCV to determine if it should be reported.

12. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFPeA, PFOSA, NMePFOSAE, NMePFOSA, NEtPFOSAE, and NEtPFOSA. The expected ion ratio for each compound is calculated by using the average of ion ratios of each compound from initial calibration standards. When an ion ratio for a compound differs from the expected ion ratio by more than 50%, a qualifier is placed on the raw data and on the sample report. No corrective action is required.

13. The linear/branch chain standard is used when assessing the correctness of the computer generated peak integrations for PFOA.

14. If the calculated concentration exceeds the calibration range of the system, determine the appropriate dilution required and dilute the extract with MeOH. If the sample dilution required exceeds 100 fold, the client must be contacted to determine if the data can be reported with result(s) that exceed the calibration range or if the sample should be re-prepped at a reduced volume.

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Dilution Example 1/10: Mix 900 µL of MeOH with 100 µL of sample extract. Vortex to mix. Using an auto-pipette, transfer 400 µL of the mixed solution into a labeled auto-sampler vial containing a plastic insert. Using an auto-pipette, add 20 µL of labeled injection std to the 400 µL aliquot. Cap and vortex thoroughly to mix.

## Calculations

### A. Peak Area Ratio

$$\text{Peak Area Ratio} = \frac{\text{Analyte Response}}{\text{Labeled Analyte Response}}$$

### B. Analyte Concentration using linear through zero curves (MQ Data processing system)

Concentration = (area ratio ÷ slope) x Dilution Factor x Internal Standard concentration

C. Sample Concentration (used only for solids using the MultiQuant data processing system on the AB Sciex LC/MS/MS)

Sample concentration (ng/g) = Calc conc x (Sample volume ÷ Sample weight) x prep factor x DF

Where: prep factor = 2

### D. Ion Ratio

ion ratio = (peak area or height of quantifier)/(peak area or height of qualifier)



E. See [T-PEST-WI9847](#) for additional calculations used to evaluate the calibrations and quality control samples.

## Statistical Information/Method Performance

The LCS should contain all compounds of interest. LCS, MS, extraction standard recoveries and RPD are compared to the limits stored on the LIMS. These limits are statistically derived when sufficient data points are available. If sufficient data points are not available to generate statistical windows, an advisory window of 70% to 130% will be used. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to [QA-SOP11892](#) for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor.

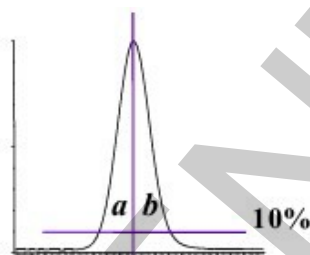
The initial demonstration of capability for this method has been carried out as listed below.

1. Initial Demonstration of Low System Background - Performed any time a new lot of SPE cartridges, solvents, centrifuge tubes, disposable pipettes and autosampler vials are used.
  - a. No peaks are present within the retention time window of any analyte that would prevent the determination of that analyte. If any peaks are present, determine the source of the contamination and eliminate the interference before sample analysis.
  - b. Background from method analytes must be below 1/3 of the MRL.
2. Initial Demonstration of Peak Asymmetry factor - Performed during the IDC and every time a new calibration curve is generated.

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- a. Calculate the peak asymmetry factors for the first two eluting peaks in a mid-level CAL standard using the following equation:

$$A_s = \frac{b}{a}$$



where:

$A_s$  = peak asymmetry factor

$B$  = width of the back half of the peak measured (at 10% peak height) from the trailing edge of the peak to a line dropped perpendicularly from the peak apex

$a$  = the width of the front half of the peak measured (at 10% peak height) from the leading edge of the peak to a line dropped perpendicularly from the apex.

- b. Peak asymmetry factors must fall in the range of 0.8 to 1.
- c. If the criteria are not met, corrective action must be taken prior to sample analysis.
3. Minimum Reporting Level (MRL) confirmation
- a. Fortify, extract, and analyze seven replicate LFBs at the proposed MRL concentration.
- b. Calculate the mean measured concentration and standard deviation of the replicates.
- c. Determine the Half Range for the prediction interval of results ( $HR_{PIR}$ ) using the equation below:

$$HR_{PIR} = 3.963s$$

where

$s$  = the standard deviation



3.963 = a constant value for seven replicates.

- d. The Upper PIR limit must be  $\leq 150\%$  recovery using the equation below:

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

- e. The Lower PIR Limit must be  $\geq 50\%$  recovery using the equation below:

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

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f. The MRL is validated if both the Upper and Lower PIR limits meet the criteria

g. If the criteria is not met, the MRL is too low and must be determined again at a higher concentration.

## Quality Assurance/Quality Control

For each batch of 20 samples extracted, a method blank and an LCS/LCSD (Milli-Q water spiked with all compounds to be determined carried through the entire procedure) must be extracted and analyzed. If an MSD is submitted, an LCSD would not be extracted. A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed instead. Statistical control limits must be calculated for recoveries of LCS and MS when sufficient data points have been collected.

### Attachment:

Attachment 1 - PROPRIETARY  
 Attachment 10 - PROPRIETARY  
 Attachment 11 - Requirements for Minnesota SCM and non-NPW samples (.doc)  
 Attachment 2 - Mass Transitions (.doc)  
 Attachment 3 -Compound Relationships (.docx)  
 Attachment 4 - Example Certificate of Analysis (.pdf)  
 Attachment 5 - PROPRIETARY  
 Attachment 6 - PROPRIETARY  
 Attachment 7 - PROPRIETARY  
 Attachment 8 - PROPRIETARY  
 Attachment 9 - PROPRIETARY

G-DC-FRM23907 Redacted SOPs

QA-SOP11178 Demonstrations of Capability

QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation

T-PEST-WI9847 Common Equations Used During Chromatographic Analyses

T-PFAS-WI13881 Standards Management in the PFAS Laboratory

Attachment: Attachment 1 - PROPRIETARY

Attachment: Attachment 10 - PROPRIETARY

Attachment: Attachment 11 - Requirements for Minnesota SCM and non-NPW samples (doc)

Attachment: Attachment 2 - Mass Transitions (doc)

Attachment: Attachment 3 -Compound Relationships (docx)

Attachment: Attachment 4 - Example Certificate of Analysis (pdf)

Attachment: Attachment 5 - PROPRIETARY

Attachment: Attachment 6 - PROPRIETARY

Attachment: Attachment 7 - PROPRIETARY

Attachment: Attachment 8 - PROPRIETARY

Attachment: Attachment 9 - PROPRIETARY

End of document

## Version history

Version	Approval	Revision information
8.1	25.SEP.2019	
9	28.OCT.2019	
10	12.MAY.2020	

## Attachment 11

### Requirements for Minnesota SCM and non-NPW samples

- A. Initial Calibration criteria
  - 1. %RSD  $\leq$  20% for all analytes.
  - 2. Low point of the curve – %D 70-130%, all other points 75-125%
- B. Continuing Calibration criteria
  - 1. All CCVs are analyzed at mid-level of initial calibration curve
  - 2. %D(difference) must be  $\pm$  30% of the true value
  - 3. If the %D is  $>$  +30%, and the target is not detected in the sample, the data can be used with an appropriate qualifier.
- C. QC Recovery - isotopically labeled compounds
  - Isotope dilution labeled recoveries 50-200%
- D. Batch and Matrix QC acceptance criteria
  - 1. LCS/LCSD
    - a. Spike concentrations must be 5-10X the reporting limits
    - b. LCS/LCSD Recovery 60-130% for all native compounds for SCM and non-NPW matrices
    - c. LCS/LCSD RPD  $\leq$  50% for SCM and non-NPW matrices
  - 2. MS/MSD
    - a. Spike concentrations must be 5-10X the reporting limits
    - b. MS/MSD Recovery 50-150% for all native compounds for SCM and non-NPW matrices
    - c. MS/MSD RPD  $\leq$  50% for SCM and non-NPW matrices

## Attachment 2

### Mass Transitions AB Sciex 4500

Compound	Parent Ion	Daughter Ion
13C3-PFBA	216	172
13C4-PFBA	217	172
PFBA	213	169
13C5-PFPeA	268	223
PFPeA	263	219
13C3-PFBS	302	80
PFBS	299	80
PFBS (2)	299	99
13C2-4:2-FTS	329	81
4:2-FTS	327	307
4:2-FTS (2)	327	81
13C5-PFHxA	318	273
PFHxA	313	269
PFHxA (2)	313	119
PFPeS	349	80
PFPeS (2)	349	99
13C3-PFHxS	402	80
PFHxS	399	80
PFHxS (2)	399	99
13C4-PFHpA	367	322
PFHpA	363	319
PFHpA (2)	363	169
13C2-6:2-FTS	429	81
6:2-FTS	427	407
6:2-FTS (2)	427	81
PFHpS	449	80
PFHpS (2)	449	99
13C2-PFOA	415	370
13C8-PFOA	421	376
PFOA	413	369
PFOA (2)	413	169
13C4-PFOS	503	80
13C8-PFOS	507	80
PFOS	499	80
PFOS (2)	499	99
13C9-PFNA	472	427
PFNA	463	419

## Attachment 2

Compound	Parent Ion	Daughter Ion
PFNA (2)	463	169
13C8-PFOSA	506	78
PFOSA	498	78
PFNS	549	80
PFNS (2)	549	99
13C2-PFDA	515	470
13C6-PFDA	519	474
PFDA	513	469
PFDA (2)	513	169
13C2-8:2-FTS	529	81
8:2-FTS	527	507
8:2-FTS (2)	527	81
d7-NMePFOSAE	623	59
NMePFOSAE	616	59
d3-NMePFOSA	515	169
NMEPFOSA	512	169
d3-NMeFOSAA	573	419
NMeFOSAA	570	419
NMeFOSAA (2)	570	483
d9-NEtPFOSAE	639	59
NEtPFOSAE	630	59
d5-NETPFOSA	531	169
NEtPFOSA	526	169
PFDS	599	80
PFDS (2)	599	99
13C7-PFUnDA	570	525
PFUnDA	563	519
PFUnDA (2)	563	169
d5-NEtFOSAA	589	419
NEtFOSAA	584	419
NEtFOSAA (2)	584	526
13C2-PFDoDA	615	570
PFDoDA	613	569
PFDoDA (2)	613	169
10:2-FTS	627	607
10:2-FTS (2)	627	81
PFDoS	699	80
PFDoS	699	99
PFTrDA	663	619
PFTrDA (2)	663	169



## Attachment 2

Compound	Parent Ion	Daughter Ion
13C2-PFTeDA	715	670
PFTeDA	713	669
PFTeDA (2)	713	169
PFHxDA	813	769
PFHxDA (2)	813	169
PFODA	913	869
PFODA (2)	913	169
13C3-HFPODA	332	287
HFPODA	329	285
HFPODA (2)	329	169
DONA	377	251
DONA (2)	377	85
9Cl-PF3ONS	531	351
9Cl-PF3ONS (2)	531	83
11Cl-PF3OUdS	631	451
11Cl-PF3OUdS (2)	631	99

### Attachment 3

#### PFAS Injection Standards/Extraction Standards/Native Compounds

##### Injection Standards

Inj Std	Internal Standard/Injection Standard
I13C3-PFBA	13C3-PFBA
I13C2-PFOA	13C2-PFOA
I13C4-PFOS	13C4-PFOS
I13C2-PFDA	13C2-PFDA

### Attachment 3

#### Extraction Standards

Extraction Standard	Internal Standard
E13C4-PFBA	13C3-PFBA
E13C5-PFPeA	
E13C3-PFBS	
E13C2-4:2-FTS	13C2-PFOA
E13C5-PFHxA	
E13C3-PFHxS	
E13C4-PFHpA	
E13C2-6:2-FTS	
E13C8-PFOA	
13C3-HFPODA	
E13C8-PFOS	13C4-PFOS
E13C9-PFNA	
E13C8-PFOSA	13C2-PFDA
E13C6-PFDA	
E13C2-8:2-FTS	
Ed7-NMePFOSAE	
Ed3-NMePFOSA	
Ed3-NMeFOSAA	
Ed9-NEtPFOSAE	
Ed5-NEtPFOSA	
E13C7-PFUnDA	
Ed5-NEtFOSAA	
E13C2-PFDoDA	
E13C2-PFTeDA	

### Attachment 3

#### Native PFAS Compounds

Native	Extraction Standard
PFBA	13C4-PFBA
PFPeA	13C5-PFPeA
PFBS	13C3-PFBS
PFPeS	
4:2-FTS	13C2-4:2-FTS
PFHxA	13C5-PFHxA
PFHxS	13C3-PFHxS
PFHpS	
PFHpA	13C4-PFHpA
DONA	
6:2-FTS	13C2-6:2-FTS
PFOA	13C8-PFOA
PFOS	13C8-PFOS
PFNS	
PFDS	
9Cl-PF3ONS	
11Cl-pf3OUdS	
PFDoS	
PFNA	13C9-PFNA
PFOSA	13C8-PFOSA
PFDA	13C6-PFDA
8:2-FTS	13C2-8:2-FTS
10:2-FTS	
NMePFOSAE	d7-NMePFOSAE
NMePFOSA	d3-NMePFOSA
NMeFOSAA	d3-NMeFOSAA
NEtPFOSAE	d9-NEtPFOSAE
NEtPFOSA	d5-NEtPFOSA
PFUnDA	13C7-PFUnDA
NEtFOSAA	d5-NEtFOSAA

### Attachment 3

Native	Extraction Standard
PFDODA	13C2-PFDODA
PFTTrDA	
PFTeDA	13C2-PFTeDA
PFHxDA	
PFODA	
HFPODA	13C3-HFPODA

**WELLINGTON**  
LABORATORIES**CERTIFICATE OF ANALYSIS**  
DOCUMENTATION**PFAC-MXC****Native Perfluorinated  
Compound Solution/Mixture****PRODUCT CODE:**

PFAC-MXC

**LOT NUMBER:**

PFACMXC0617

**SOLVENT(S):**

Methanol / Water (&lt;1%)

**DATE PREPARED:** (mm/dd/yyyy)

06/14/2017

**LAST TESTED:** (mm/dd/yyyy)

03/19/2019

**EXPIRY DATE:** (mm/dd/yyyy)

03/19/2024

**RECOMMENDED STORAGE:**

Store ampoule in a cool, dark place

**DESCRIPTION:**

PFAC-MXC is a solution/mixture of thirteen native perfluoroalkylcarboxylic acids ( $C_4$ - $C_{14}$ ,  $C_{16}$ , and  $C_{18}$ ) and eight native perfluoroalkylsulfonates ( $C_4$ - $C_{10}$  and  $C_{12}$ ). The full name, abbreviation and concentration for each of the components are given in Table A.

The individual perfluoroalkylcarboxylic acids and perfluoroalkylsulfonates all have chemical purities of >98%.

**DOCUMENTATION/ DATA ATTACHED:**

Table A: Components and Concentrations of the Solution/Mixture

Figure 1: LC/MS Data (SIR)

Figure 2: LC/MS/MS Data (Selected MRM Transitions)

**ADDITIONAL INFORMATION:**

- See page 2 for further details.
- Contains 4 mole eq. of NaOH to prevent conversion of the carboxylic acids to their respective methyl esters.

**FOR LABORATORY USE ONLY: NOT FOR HUMAN OR DRUG USE**

Wellington Laboratories Inc., 345 Southgate Dr. Guelph ON N1G 3M5 CANADA  
519-822-2436 • Fax: 519-822-2849 • [info@well-labs.com](mailto:info@well-labs.com)



## ATTACHMENT 4

### **INTENDED USE:**

The products prepared by Wellington Laboratories Inc. are for laboratory use only. This certified reference material (CRM) was designed to be used as a standard for the identification and/or quantification of the specific chemical compounds it contains.

### **HANDLING:**

This product should only be used by qualified personnel familiar with its potential hazards and trained in the handling of hazardous chemicals. Due care should be exercised to prevent unnecessary human contact or ingestion. All procedures should be carried out in a well-functioning fume hood and suitable gloves, eye protection, and clothing should be worn at all times. Waste should be disposed of according to national and regional regulations. Safety Data Sheets (SDSs) are available upon request.

### **SYNTHESIS / CHARACTERIZATION:**

Our products are synthesized using single-product unambiguous routes whenever possible. They are then characterized, and their structures and purities confirmed, using a combination of the most relevant techniques, such as NMR, GC/MS, LC/MS/MS, SFC/UV/MS/MS, x-ray crystallography, and melting point. Isotopic purities of mass-labelled compounds are also confirmed using HRGC/HRMS and/or LC/MS/MS.

### **HOMOGENEITY:**

Prior to solution preparation, crystalline material is tested for homogeneity using a variety of techniques (as stated above) and its solubility in a given diluent is taken into consideration. Duplicate solutions of a new product are prepared from the same crystalline lot and, after the addition of an appropriate internal standard, they are compared by GC/MS, LC/MS/MS, and/or SFC/UV/MS/MS. The relative response factors of the analyte of interest in each solution are required to be <5% RSD. New solution lots of existing products, as well as mixtures and calibration solutions, are compared to older lots in a similar manner. This further confirms the homogeneity of the crystalline material as well as the stability and homogeneity of the solutions in the storage containers. In order to maintain the integrity of the assigned value(s), and associated uncertainty, the dilution or injection of a subsample of this product should be performed using calibrated measuring equipment.

### **UNCERTAINTY:**

The maximum combined relative standard uncertainty of our reference standard solutions is calculated using the following equation:

The combined relative standard uncertainty,  $u_c(y)$ , of a value  $y$  and the uncertainty of the independent parameters

$x_1, x_2, \dots, x_n$  on which it depends is:

$$u_c(y(x_1, x_2, \dots, x_n)) = \sqrt{\sum_{i=1}^n u(y, x_i)^2}$$

where  $x$  is expressed as a relative standard uncertainty of the individual parameter.

The individual uncertainties taken into account include those associated with weights (calibration of the balance) and volumes (calibration of the volumetric glassware). An expanded maximum combined percent relative uncertainty of  $\pm 5\%$  (calculated with a coverage factor of 2 and a level of confidence of 95%) is stated on the Certificate of Analysis for all of our products.

### **TRACEABILITY:**

All reference standard solutions are traceable to specific crystalline lots. The microbalances used for solution preparation are regularly calibrated by an external ISO/IEC 17025 accredited laboratory. In addition, their calibration is verified prior to each weighing using calibrated external weights traceable to an ISO/IEC 17025 accredited laboratory. All volumetric glassware used is calibrated, of Class A tolerance, and traceable to an ISO/IEC 17025 accredited laboratory. For certain products, traceability to international interlaboratory studies has also been established.

### **EXPIRY DATE / PERIOD OF VALIDITY:**

Ongoing stability studies of this product have demonstrated stability in its composition and concentration, until the specified expiry date, in the unopened ampoule. Monitoring for any degradation or change in concentration of the listed analyte(s) is performed on a routine basis.

### **LIMITED WARRANTY:**

At the time of shipment, all products are warranted to be free of defects in material and workmanship and to conform to the stated technical and purity specifications.

### **QUALITY MANAGEMENT:**

This product was produced using a Quality Management System registered to the latest versions of ISO 9001 by SAI Global, ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA; A 1226), and ISO 17034 by ANSI-ASQ National Accreditation Board (ANAB; AR-1523).



\*\*For additional information or assistance concerning this or any other products from Wellington Laboratories Inc., please visit our website at [www.well-labs.com](http://www.well-labs.com) or contact us directly at [info@well-labs.com](mailto:info@well-labs.com)\*\*




# ATTACHMENT 4

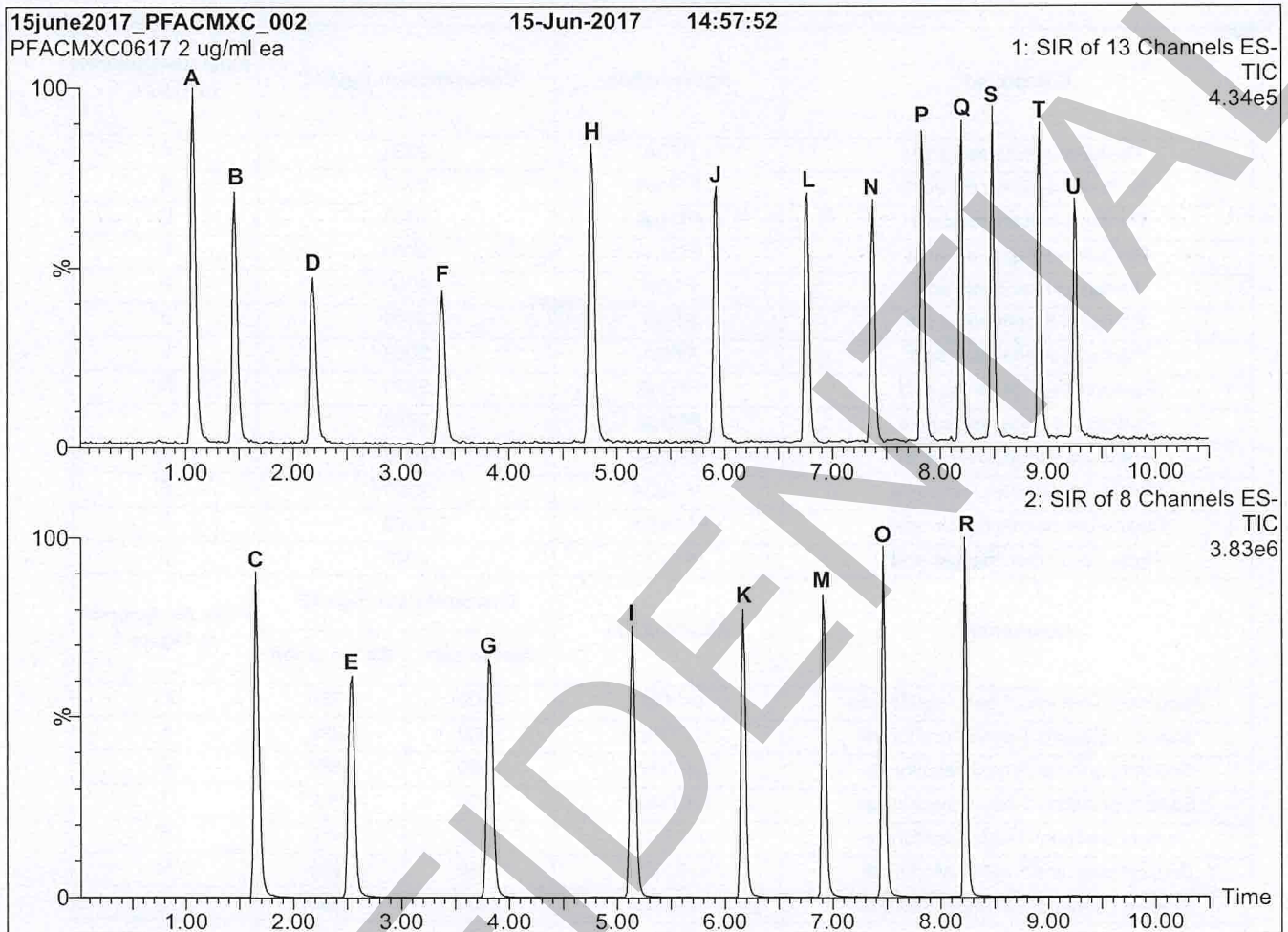
**Table A:** PFAC-MXC; Components and Concentrations (ng/ml,  $\pm$  5% in Methanol / Water (<1%))

Compound	Abbreviation	Concentration (ng/ml)*		Peak Assignment in Figure 1
Perfluoro-n-butanoic acid	PFBA	2000		A
Perfluoro-n-pentanoic acid	PFPeA	2000		B
Perfluoro-n-hexanoic acid	PFHxA	2000		D
Perfluoro-n-heptanoic acid	PFHpA	2000		F
Perfluoro-n-octanoic acid	PFOA	2000		H
Perfluoro-n-nonanoic acid	PFNA	2000		J
Perfluoro-n-decanoic acid	PFDA	2000		L
Perfluoro-n-undecanoic acid	PFUdA	2000		N
Perfluoro-n-dodecanoic acid	PFDoA	2000		P
Perfluoro-n-tridecanoic acid	PFTTrDA	2000		Q
Perfluoro-n-tetradecanoic acid	PFTeDA	2000		S
Perfluoro-n-hexadecanoic acid	PFHxDA	2000		T
Perfluoro-n-octadecanoic acid	PFODA	2000		U
Compound	Abbreviation	Concentration (ng/ml)*		Peak Assignment in Figure 1
		As the salt	As the anion	
Potassium perfluoro-1-butanedisulfonate	L-PFBS	2000	1770	C
Sodium perfluoro-1-pentadisulfonate	L-PFPeS	2000	1880	E
Sodium perfluoro-1-hexadisulfonate	L-PFHxS	2000	1890	G
Sodium perfluoro-1-heptadisulfonate	L-PFHpS	2000	1900	I
Sodium perfluoro-1-octadisulfonate	L-PFOS	2000	1910	K
Sodium perfluoro-1-nonadisulfonate	L-PFNS	2000	1920	M
Sodium perfluoro-1-decadisulfonate	L-PFDS	2000	1930	O
Sodium perfluoro-1-dodecadisulfonate	L-PFDoS	2000	1940	R

\* Concentrations have been rounded to three significant figures.

Certified By:   
B.G. Chittim, General Manager

Date: 06/06/2019  
(mm/dd/yyyy)

**Figure 1:** PFAC-MXC; LC/MS Data (Total Ion Current Chromatogram; SIR)**Conditions for Figure 1:**

**LC:** Waters Acquity Ultra Performance LC  
**MS:** Micromass Quattro *micro* API MS

**Chromatographic Conditions**

**Column:** Acquity UPLC BEH Shield RP<sub>18</sub>  
 1.7  $\mu$ m, 2.1 x 100 mm

**Mobile phase:** Gradient  
 Start: 50% H<sub>2</sub>O / 50% (80:20 MeOH:ACN)  
 (both with 10 mM NH<sub>4</sub>OAc buffer)  
 Ramp to 90% organic over 8 min and hold for 2 min  
 before returning to initial conditions in 1 min.

**Time:** 12 min

**Flow:** 300  $\mu$ l/min

**MS Parameters**

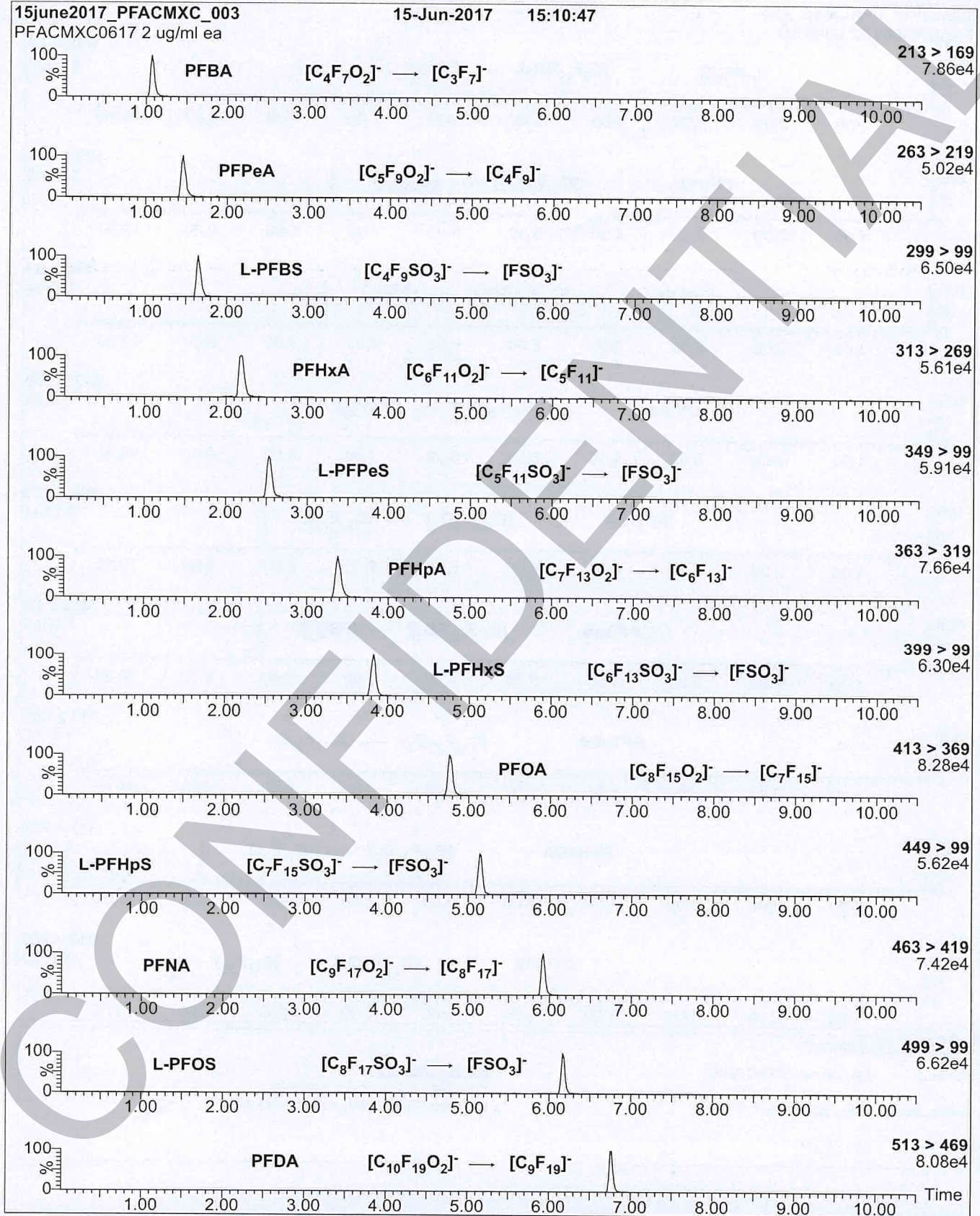
Experiment: SIR of 21 Channels

Source: Electrospray (negative)  
 Capillary Voltage (kV) = 3.00  
 Cone Voltage (V) = variable (10-80)  
 Cone Gas Flow (l/hr) = 50  
 Desolvation Gas Flow (l/hr) = 750



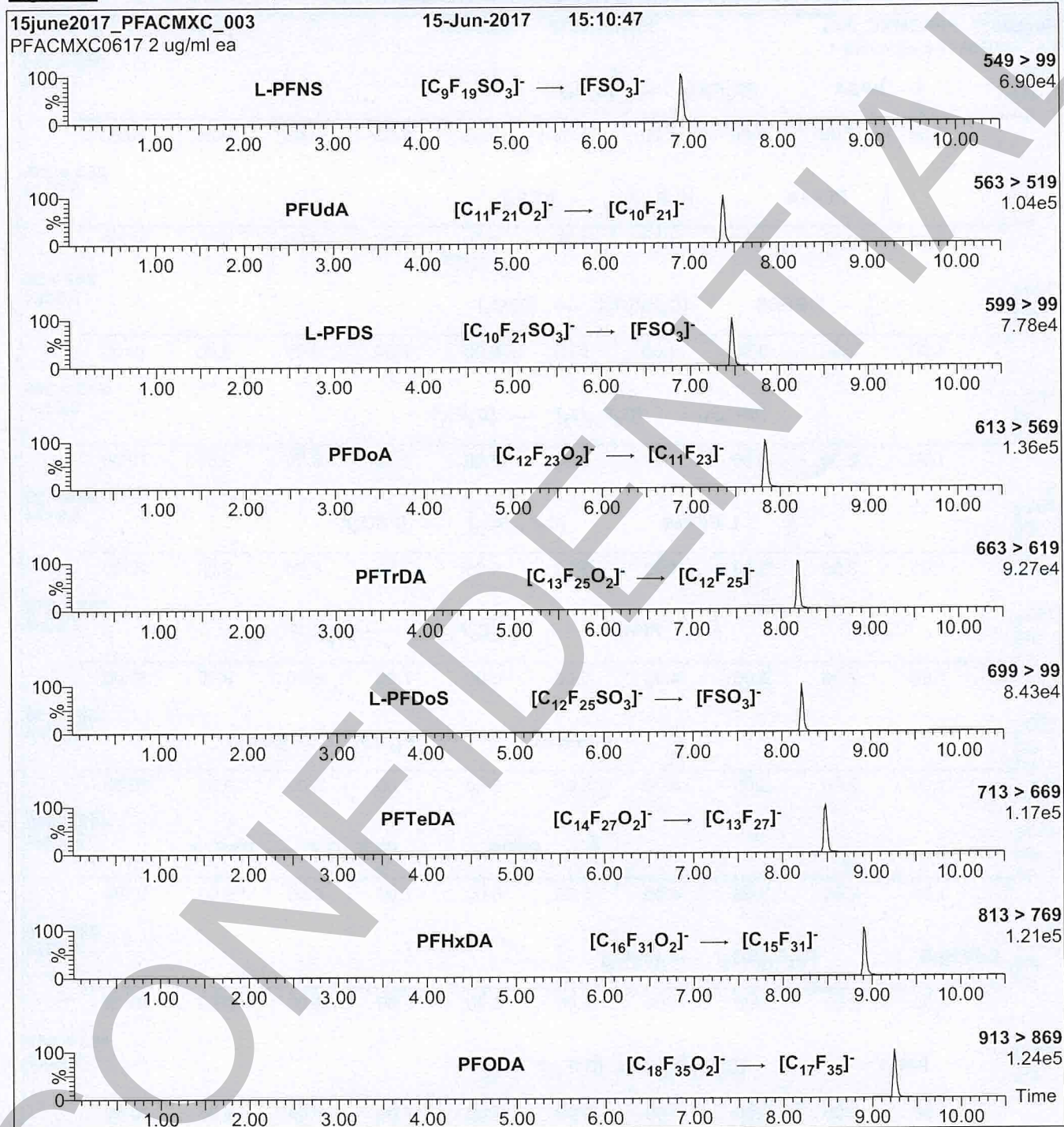
# ATTACHMENT 4

**Figure 2: PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**



# ATTACHMENT 4

**Figure 2: PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**



**Conditions for Figure 2:**

Injection: On-column (PFAC-MXC)



Mobile phase: Same as Figure 1

Flow: 300  $\mu$ l/min

**MS Parameters**

Collision Gas (mbar) = 3.46e-3

Collision Energy (eV) = 8-50 (variable)

	Always check on-line for validity.	Level: 
Document number: <b>T-PFAS-WI14355</b>	<b>Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by EPA Method 537 Isotope Dilution; and for WV only - SW-846 8321B, Using LC/MS/MS</b>	<b>Work Instruction</b>
Old Reference: <b>1-P-QM-WI-9039651 (1-P-QM-WI-9012802)</b>		Organisation level: <b>5-Sub-BU</b>
Version: <b>13</b>		Responsible: <b>5_EUUSLA_PFAS_Manager</b>
Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b>	Document users: <b>5_EUUSLA_PFAS_Manager,</b> <b>6_EUUSLA_PFAS_Analyst,</b> <b>6_EUUSLA_PFAS_Data_Reviewers,</b> <b>6_EUUSLA_PFAS_Management_Team,</b> <b>6_EUUSLA_PFAS_Sample_Prep</b>	

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## LIMS ID

14091, 14343, 14473

A redacted version of this SOP is available in G-DC-FRM23907 due to the proprietary nature of its contents.



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## Revision Log



 <p>Document number: <b>T-PFAS-WI14355</b></p> <p>Old Reference: <b>1-P-QM-WI-9039651 (1-P-QM-WI-9012802)</b></p> <p>Version: <b>13</b></p> <p>Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b></p>	<p>Always check on-line for validity.</p> <p><b>Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by EPA Method 537 Isotope Dilution; and for WV only - SW-846 8321B, Using LC/MS/MS</b></p> <p>Document users: <b>5_EUUSLA_PFAS_Manager, 6_EUUSLA_PFAS_Analyst, 6_EUUSLA_PFAS_Data_Reviewers, 6_EUUSLA_PFAS_Management_Team, 6_EUUSLA_PFAS_Sample_Prep</b></p>	<p>Level: </p> <p><b>Work Instruction</b></p> <p>Organisation level: <b>5-Sub-BU</b></p> <p>Responsible: <b>5_EUUSLA_PFAS_Manager</b></p>
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	<b>Revision:</b> 13	<b>Effective date:</b> This version
<b>Section</b>	<b>Justification</b>	<b>Changes</b>
Revision Log	Formatting requirement	Removed revision logs up to the previous version
Scope	Corrected typographical error	Removed perfluoroundecanoic acid from the N-ethylperfluoro-1-octanesulfonamidoacetic acid analyte name field
Apparatus and Equipment	Reflect current protocol	Added AB Sciex 5500/5500 plus, add automated pipette, removed all glass
Reagents and Standards	Typographical error correctio	Changed 0.35% NH4OH to 0.3% NH4OH, reagent 6 add or until degradation is observed
Calibration	Reflect current protocol	Removed reference to an MDL standard. Low point of the calibration curve is at the MDL. Added requirement for quadratic curve = 6 points minimum
<a href="#">Attachment 1</a> and Procedure	Enhancement	Att1: PFOS(2) transition masses corrected to 499 and 99. Added 2nd masses to table for all but PFBA ,PFPeA, PFOSA, NMePFOSAE, NMEPFOSA, NEtPFOSAE, and NEtPFOSA. Procedure update verbiage to say only PFBA, PFPeA, PFOSA, NMePFOSAE, NMEPFOSA, NEtPFOSAE, and NEtPFOSA. Do not have 2nd transitions.
<a href="#">Attachment 11</a> and throughout document	Enhancement	Added reference to <a href="#">Attachment 6</a> throughout document. Added attachment 6 for requirements of samples from the state of MN.
Calculations	Enhancement	added ion ratio calculation
Procedure G.11-12	Enhancement	added Ion ratio and retention time criteria
Procedure A.1	Enhancement	added reference for Dispersion procedure and attachment 5.
Procedure B.12	Reflect current protocol	Removed verbiage related to the MDL standard.
Procedure B.7	Clarification	Updated processing for determining if an SPE cartridge is dry
Procedure B.13	Reflect current protocol	Updated sample extract dilution protocol

<b>Revision:</b> 12	<b>Effective Date:</b>	17-OCT-2019
<b>Section</b>	<b>Justification</b>	<b>Changes</b>



 Document number: <b>T-PFAS-WI14355</b> Old Reference: <b>1-P-QM-WI-9039651 (1-P-QM-WI-9012802)</b> Version: <b>13</b>	Always check on-line for validity.  <b>Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by EPA Method 537 Isotope Dilution; and for WV only - SW-846 8321B, Using LC/MS/MS</b>	Level:   <b>Work Instruction</b>  Organisation level: <b>5-Sub-BU</b>
Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b>	Document users: <b>5_EUUSLA_PFAS_Manager,</b> <b>6_EUUSLA_PFAS_Analyst,</b> <b>6_EUUSLA_PFAS_Data_Reviewers,</b> <b>6_EUUSLA_PFAS_Management_Team,</b> <b>6_EUUSLA_PFAS_Sample_Prep</b>	Responsible: <b>5_EUUSLA_PFAS_Manager</b>

Revision:	12	Effective Date:	17-OCT-2019
Revision Log	Formatting requirement	Removed revision logs up to the previous version	
Cross Reference and Personnel Training and Qualifications	Enhancement	add <a href="#">QA-SOP11178</a>	
Calibration	Enhancement	Added attachment 4 and note about salt/anion (acid) concentrations. added reference to	
Procedure	Enhancement	Added reference to attachment 1. Added procedure for non aqueous sample preparation and verbiage about sample bottles that are submitted without full volume.	

## Reference

1. US EPA Method 537, Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LCMSMS), Version 1.1, September 2009.
2. Standard Test Method for Determination of Perfluorinated Compounds in Soil by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS), ASTM Method D7968, 2014.
3. ISO 25101:2009(E) Water quality, Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA); Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry, March 2009.
4. Test Methods for Evaluating Solid Wastes, SW-846 Method 8321B, Solvent Extractable Non-Volatile Compounds by High Performance Liquid Chromatography/Thermospray Mass Spectrometry or Ultraviolet Detection, Rev 2, January 1998.
5. Determinative Chromatographic Separations, SW-846, Method 8000D, July 2014.
6. Method for Trace Level Analysis of C8, C9, C10, C11, and C13 Perfluorocarbon Carboxylic Acids in Water. Karen Risha, John Flaherty, Roice Wille, Warren Buck, Francesco Morandi, and Tsuguhide Isemura. Anal. Chem. 2005, 77, 1503-1508.
7. *Chemical Hygiene Plan*, current version.



 <p>Document number: <b>T-PFAS-WI14355</b></p> <p>Old Reference: <b>1-P-QM-WI-9039651 (1-P-QM-WI-9012802)</b></p> <p>Version: <b>13</b></p>	<p>Always check on-line for validity.</p> <p><b>Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by EPA Method 537 Isotope Dilution; and for WV only - SW-846 8321B, Using LC/MS/MS</b></p>	<p>Level: </p> <p><b>Work Instruction</b></p>
<p>Approved by: <b>XL3S</b></p> <p>Effective Date <b>16-JUN-2020</b></p>	<p>Document users: <b>5_EUUSLA_PFAS_Manager, 6_EUUSLA_PFAS_Analyst, 6_EUUSLA_PFAS_Data_Reviewers, 6_EUUSLA_PFAS_Management_Team, 6_EUUSLA_PFAS_Sample_Prep</b></p>	<p>Organisation level: <b>5-Sub-BU</b></p> <p>Responsible: <b>5_EUUSLA_PFAS_Manager</b></p>



## Cross Reference

Document	Document Title
<a href="#">T-PEST-WI9847</a>	Common Equations Used During Chromatographic Analyses
<a href="#">T-PFAS-WI13881</a>	Standards Management in the PFAS Laboratory
<a href="#">QA-SOP11178</a>	Demonstrations of Capability
<a href="#">QA-SOP11892</a>	Determining Method Detection Limits and Limits of Quantitation



## Scope

This method is applicable for the determination of selected per- and polyfluorinated alkyl substances (PFAS) in aqueous samples to include non-potable waters and non-regulatory potable water when directed by the client. The compounds analyzed in this method are listed in the table below. The most current MDLs and LOQs are listed in the LIMS.

Analyte	Acronym	CAS#
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorododecanoic acid	PFDODA	307-55-1
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorotetradecanoic acid	PFTeDA	376-06-7
Perfluorotridecanoic acid	PFTTrDA	72629-94-8
Perfluoroundecanoic acid	PFUnDA	2058-94-8

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Version: <b>13</b>	Document users: <b>5_EUUSLA_PFAS_Manager,          6_EUUSLA_PFAS_Analyst,          6_EUUSLA_PFAS_Data_Reviewers,          6_EUUSLA_PFAS_Management_Team,          6_EUUSLA_PFAS_Sample_Prep</b>	Organisation level: <b>5-Sub-BU</b>
Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b>		Responsible: <b>5_EUUSLA_PFAS_Manager</b>

Analyte	Acronym	CAS#
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
8:2 - Fluorotelomersulfonic acid	8:2FTS	39108-34-4
N-methylperfluoro-1-octanesulfonamidoacetic acid	NMeFOSAA	2355-31-9
N-ethylperfluoro-1-octanesulfonamidoacetic acid	NEtFOSAA	2991-50-6
4:2-Fluorotelomersulfonic acid	4:2-FTS	757124-72-4
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
6:2-Fluorotelomersulfonic acid	6:2-FTS	27619-97-2
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorononanesulfonic acid	PFNS	68259-12-1
Perfluorodecanesulfonic acid	PFDS	335-77-3
10:2-Fluorotelomersulfonic acid	10:2-FTS	120226-60-0
Perfluorododecanesulfonic acid	PFDODS	79780-39-5
Perfluorohexadecanoic acid	PFHxDA	67905-19-5
Perfluorooctadecanoic acid	PFODA	16517-11-6
Perfluorooctanesulfonamide	PFOSA	754-91-6
2-(N-methylperfluoro-1-octanesulfonamido)- ethanol	NMePFOSAE	24448-09-7
N-methylperfluoro-1-octanesulfonamide	NMePFOSA	31506-32-8
2-(N-ethylperfluoro-1-octanesulfonamido) - ethanol	NEtPFOSAE	1691-99-2
N-ethylperfluoro-1-octanesulfonamide	NEtPFOSA	4151-50-2
2,3,3,3-Tetrafluoro-2-(1,1,2,2,3,3,3-heptafluoropropoxy)-propanoic acid	HFPODA	13252-13-6
	DONA **	919005-14-4 *

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Analyte	Acronym	CAS#
Ammonium 4,8-dioxa-3H-perfluorononanoic acid		
Potassium 9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1 *
Potassium 11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9 *

\*CAS# for the free acid form of the analyte

\*\*Acronym for the free acid form of the analyte



## Basic Principles

A 250-mL aqueous sample is fortified with isotopically-labeled extraction standards and is passed through a solid phase extraction (SPE) cartridge to extract the analytes. The compounds are eluted from the solid phase with a combination of solvents. The extract is concentrated to ~400-500µl with nitrogen in a heated water bath, and then reconstituted to 1 ml with methanol. Isotopically-labeled injection internal standards are added to the sample extract and it is analyzed by LC/MS/MS operated in negative electrospray ionization (ESI) mode for detection and quantification of the analytes. Quantitative analysis is performed using isotope dilution.

## Reference Modifications

EPA Method 537 is written specifically for the analysis of drinking water samples. The following modifications to the method have been made to accommodate all aqueous samples.

1. A labeled isotopic analog is spiked into samples for all compounds where an isotopic analog is commercially available. These isotopic compounds are referred to as extraction standards. For those compounds, an isotope dilution calibration model is used. Where labeled isotopes are not available, an internal standard calibration model using the extraction standards is used.
2. Prior to instrumental analysis, separate but similar isotopic analogs are added to the sample extract. Using an internal standard calibration model these injection standards are used to calculate recoveries of the extraction standards.
3. Field reagent blanks are not processed as listed in EPA 537 Version 1.1 section 8.3

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- Trizma is not used for waters except in the cases where the water comes from a chlorinated water source.
- Spike concentrations are not rotated between low, medium and high levels.
- SPE is used for sample preparation. Cartridge types and elution profiles differ from EPA 537 Version 1.1

MDL studies and IDOCs have been performed to validate method performance.

## Interferences

Compounds which have similar structures to the compounds of interest and similar molecular weights would potentially interfere. Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, etc. A laboratory blank is performed with each batch of samples to demonstrate that the extraction system is free of contaminants.



## Precaution to Minimize Method Interference

- LC system components contain many of the target analytes. To minimize the background PFAS peaks, PTFE solvent frits and tubing are replaced by PEEK™ solvent frits and tubing where possible.
- PROPRIETARY CONTENT
- PFAS standards, extracts and samples should not come in contact with any glass containers as these analytes can potentially adsorb to glass surfaces. PFAS analytes and internal standards commercially purchased in glass ampules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers.

## Safety Precautions and Waste Handling

See *Chemical Hygiene Plan* for general information regarding employee safety, waste management, and pollution prevention.

The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. PFOA has been described as "likely to be carcinogenic to humans". Each chemical should be treated as a potential health hazard and exposure to these chemicals should be minimized.

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Exposure to these chemicals must be reduced to the lowest possible level by whatever means available, such as fume hoods, lab coats, safety glasses, and gloves. Gloves, lab coats, and safety glasses should be worn when preparing standards and handling samples. Avoid inhaling solvents and chemicals and getting them on the skin. Wear gloves when handling neat materials. When working with acids and bases, take care not to come in contact and to wipe any spills. Always add acid to water when preparing reagents containing concentrated acids.

All laboratory waste is accumulated, managed, and disposed of in accordance with all Federal, State, and local laws and regulations. All solvent waste and extracts are collected in approved solvent waste containers in the laboratory and subsequently emptied by personnel trained in hazardous waste disposal into the lab-wide disposal facility. HPLC vials are disposed of in the lab container for waste vials, and subsequently lab packed. Any solid waste material (disposable pipettes and broken glassware, etc.) may be disposed of in the normal solid waste collection containers.

## Personnel Training and Qualifications

All personnel performing this procedure must have documentation of reading, understanding, and agreeing to follow the current version of this SOP and an annual documented Demonstration of Capability (DOC).

Each chemist performing the extraction must work with an experienced employee for a period of time until they can independently perform the extraction. Also, several batches of sample extractions must be performed under the direct observation of another experienced chemist to assure the trainee is capable of independent preparation. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).



Each LC/MS/MS analyst must work with an experienced employee for a period of time until they can independently calibrate the LC/MS/MS, review and process data, and perform maintenance procedures. Proficiency is measured through a documented Initial Demonstration of Capability (IDOC).

The IDOC and DOC consist of four laboratory control samples (or alternatively, one blind sample for the DOC) that is carried through all steps of the extraction and meets the defined acceptance criteria. The criteria include the calculation of mean accuracy and standard deviation.

See [QA-SOP11178](#) for additional information on IDOC and DOC.

## Sample Collection, Preservation, and Handling

### A. Sample Collection

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The samples are collected in 250-mL polyethylene bottles. Keep the sample sealed from time of collection until extraction.

**NOTE:** PFAS contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

## B. Sample Storage and Shipment



1. Samples must be chilled during shipment and must not exceed 10°C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10°C when the samples are received at the laboratory.
2. Samples stored in the lab must be held at a temperature of 0° to 6°C, not frozen, until extraction.
3. Water samples must be extracted within 14 days. Extracts must be analyzed within 28 days after extraction. Extracts are stored at room temperature.

## Apparatus and Equipment

### A. Apparatus

1. 250-mL HDPE bottles: Scientific Specialties; # 334008-blk-1, or equivalent.
2. Centrifuge tubes – 15-mL conical polypropylene with polypropylene screw caps; Fisher Scientific, Cat. No. 05-539-5 or equivalent
3. 10-mL polypropylene volumetric flask, Class A – Fisher Scientific, Cat. No. S02288 or equivalent.
4. HPDE bottles for extraction fluid storage: L; Environmental Sampling Supply, Cat. No. 1000-1902-PC.
5. Analytical Balance – Capable of weighing to 0.0001 g
6. Top-Loading Balance – Capable of weighing to 0.01 g
7. Through 10. – PROPRIETARY CONTENT
- 11 SPE vacuum extraction manifold –“Resprep” 24-port manifold; Restek Corp catalog # 26080, or equivalent.
12. Polypropylene SPE delivery needles – Agilent; Cat. No. 12234511.



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13. Centrifuge – “Q-Sep 3000”; Restek Corp. Cat. No. 26230, or equivalent, capable of a minimum rotational speed of 3000 rpm.

14. Disposable polyethylene pipette – Fisher Scientific, Cat. No. S30467-1 or equivalent.

15. Auto Pipettes – Eppendorf; capable of accurately dispensing 10- to 1000-μL. Fisher Scientific cat # 14-287-150, or equivalent.

16. Polypropylene pipette tips: 0-200μl. Fisher; Cat. No. 02-681-135

17. Polypropylene pipette tips: 101-1000μl. Fisher, Cat. No. 02-707-508

18. Pipettes – Disposable transfer. Fisher Scientific, Cat. No. 13-711-7M

19. Vortex mixer, variable speed, Fisher Scientific or equivalent.

20. N-Evap sample extract concentrator with N<sub>2</sub> supply and water bath for temperature control. Organomation, Inc. Cat. #11250, or equivalent.

21. Reagent Water Purification System: Capable of producing ultrapure “Type 1/Milli-Q”-grade water from in-house deionized water system. Millipore SAS; Cat. No. FTPF08831.

22. Thermo Target PP Polyspring inserts, catalog number C4010-630P

23. Agilent 9mm vial kit pack, catalog number 5190-2278, or equivalent

24. Centrifuge tubes – 50-mL conical polypropylene with polypropylene screw caps; Fisher Scientific, Cat. No. 06-443-21 or equivalent

25. Polypropylene bottles for standard storage - 4 mL; Fisher Scientific, Cat. No. 2006-9125



26. Stainless steel spatula/scoop set. Bel-Art SP Scienceware; Product # 11-865-130.

## B. Equipment

1. AB Sciex Triple Quad 4500/5500/5500 Plus Turbo V Ion Source

ExionLC Controller  
 ExionLC AC Pump  
 ExionLC AC Autosampler  
 Exion AC Column Oven  
 Data system –Analyst 1.6.3



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## 2. HPLC columns

PROPRIETARY CONTENT

## Reagents and Standards

All solvents, acids, and bases are stored in glass bottles in flammable proof cabinets or pressure resistant steel drums. Solvents, acids, and bases are stored at ambient temperature for up to 1 year. All non-solvents are stored according to manufacturer's storage conditions.

### A. Reagents:

PROPRIETARY CONTENT

### B. Standards: See SOP [T-PFAS-WI13881](#).

## Calibration

### A. Initial Calibration

1. A minimum of five calibration standards are required. In general, Cal1, Cal2, Cal3, Cal4, Cal5, Cal6, and Cal 7 are included in the initial calibration. The calibration standards contain the branched isomers for PFHxS, PFOS, NMeFOSAA, and NeFOSAA. S/N ratio must be  $\geq 10:1$  for all ions used for quantification.



2. Analyze a Cal3 level standard that contains linear and branch chained isomers of PFOA. The analysis of this standard is used to demonstrate where the branch chained isomers elute and not included in the calibration curve. This will assist the chemist in identifying and properly integrating this compound in samples.

3. Fit the curve with a linear through zero or linear with a concentration weighing factor of  $1/x$  or quadratic regression with a concentration weighing factor  $1/x^2$ . A minimum of six calibration standards must be analyzed to use a quadratic fit.

**Note:** The concentrations referenced for the sulfonate salts, (for example PFBS, PFHxS, and PFOS) have already been corrected to the acid form by the standards supplier as noted in the example Certificate of Analysis (CofA). See [Attachment 4](#).

4. Peak asymmetry factor must be calculated with each ICAL. The factor for the first two eluting peaks in the CAL5 standard must fall in the range of 0.8-1.5.

5. Isotopically-labeled compounds are not available for PFPeS, PFHpS, PFNS, PFDS, PFDoS, 10:2-FTS, PFTrA, PFHxDA, PFODA, DONA, 9CI-PF3ONS, and 11CI-PF3OUdS. See below for referenced extraction standards. See [Attachment 2](#) for additional information about compound relationships.

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<p>Approved by: <b>XL3S</b></p> <p>Effective Date <b>16-JUN-2020</b></p>	<p>Document users:</p> <p><b>5_EUUSLA_PFAS_Manager, 6_EUUSLA_PFAS_Analyst, 6_EUUSLA_PFAS_Data_Reviewers, 6_EUUSLA_PFAS_Management_Team, 6_EUUSLA_PFAS_Sample_Prep</b></p>	<p>Organisation level: <b>5-Sub-BU</b></p> <p>Responsible: <b>5_EUUSLA_PFAS_Manager</b></p>

Compound	Extraction standard
10:2-FTS	13C2-8:2-FTS
PFTTrDA	13C2-PFDoDA
PFHxDA	13C2-PFTeDA
PFODA	
PFPeS	13C3-PFBS
PFHpS	13C3-PFHxS
DONA	13C4-PFHpA
PFNS	13C8-PFOS
PFDS	
PFDoS	
9CI-PF3ONS	
11CI-PF3OUdS	

## 6. Initial calibration acceptance criteria

**Note:** See [Attachment 6](#) for requirements for samples from the state of Minnesota.



a. When each calibration point, except the lowest point (Cal1), is calculated back against the curve, the back calculated concentration should be within  $\pm 30\%$  of its true value. The lowest calibration point (Cal1) should calculate to be within  $\pm 50\%$  of its true value.

b. The  $R^2$  value for each calibration curve must be  $\geq 0.99$  for each analyte.

c. If the criteria are not met, the source of the problem must be determined and corrected. Situations may exist where the initial calibration can be used. In those cases, the data will be reported with a qualifying comment.

## 7. Initial Calibration Verification (ICV)

A check standard prepared from a second source (ICV) is injected to confirm the validity of the calibration curve/standard. If a second source is not available, a separate preparation from the same stock may be used. The calculated amount for each analyte must be within  $\pm 30\%$  of the true value. If this criteria is not met, re-inject or remake the standard. If the criteria is still not met, recalibration is necessary. Instrument maintenance may be needed prior to recalibrating.

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## B. Continuing calibration

**Note:** See [Attachment 6](#) for requirements for samples from the state of Minnesota.

1. Once the calibration curve has been established, the continuing accuracy must be verified by analysis of a continuing calibration verification (CCV) standard every ten samples and at the end of the analysis sequence.

a. The CCV run after the initial calibration must be at the CAL3 level.

b. Subsequent CCV standards should alternate between the CAL2, CAL3, and CAL4 levels of the calibration curve.

### 2. Acceptance criteria

a. The calculated amount for each compound (native and extraction standard) in the CCV standard must be within  $\pm 30\%$  of the true value. Samples that are not bracketed by acceptable CCV analyses must be reanalyzed. The exception to this would be if the CCV recoveries are high, indicating increased sensitivity, and there are no positive detections in the associated samples, the data may be reported with a qualifying comment. If two consecutive CCVs fail criteria for target analytes, two passing CCVs must be analyzed or the source of the problem determined and the system recalibrated before continuing sample analysis.

b. The absolute areas of the injection internal standards should be within 50-150% of the average areas measured during the initial calibration.

## Procedure



### A. Sample Preparation

1. Weigh sample container with contents on a calibrated top loading balance, and record the first reading in the automated prep entry system.

a. For all samples, the full bottle must be extracted. The sample must remain in the original sample container until after spiking solutions have been added. If limited sample is submitted, spike sample in original container, then add Milli-Q water to bring to final volume of 250 mL prior to SPE extraction (see B.5 for spiking details).

b. If the sample matrix is such that SPE extraction cannot be performed using the full volume, see Procedure C.

c. If the sample has dissolved and/or settleable solid content (i.e; is cloudy or has a layer of sediment/solids at the bottom of the bottle), the sample must be centrifuged in order to minimize the

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difficulty of passing through the SPE sorbent bed. In order to preserve the integrity of the sample and ensure the full volume of the container is used, see Procedure D.

d. If the sample is AFFF/Dispersion/Liquid product sample, follow the procedure listed in [Attachment 5](#).

2. Use a 250-mL HDPE bottle for the method blank and the laboratory control sample (LCS) and LCSD if needed. Fill each bottle with 250 mL of Milli-Q water. Record 250 mL as the volume for the batch QC samples on the batchlog.

#### B. Solid Phase Extraction (SPE)

##### 1. Through 16. – PROPRIETARY CONTENT

17. Reconstitute to 1.0 mL with PROPRIETARY CONTENT. Vortex to mix. Centrifuge 15 mL collection tubes for one full cycle.

18. Place each empty sample bottle on the top-loading balance and weigh. Record the second reading in the automated prep entry system. The prep entry system will calculate the sample weight. Record the calculated weight as the sample volume on the batchlog.

**Note:** The instrument lab chemist performs the next steps.

19. Transfer 400 µL of the final extract to the corresponding labeled auto-sampler vial. Add 20 µL of labeled internal standard spike to each labeled auto-sampler vial. Cap and vortex the auto-sampler vial. Samples are now ready for analysis.

20. Cap the centrifuge tube. Store the remaining centrifuged extracts at room temperature for dilution or reinjection if needed.

#### C. Reduced Sample Volume due to matrix interference



1. Determine the aliquot to be used for extraction (i.e.; 50 mL, 100 mL).

2. Label a clean 250 mL HDPE bottle with the associated ELLE sample number.

3. Label the appropriate number of 50 mL centrifuge tubes with the associated ELLE sample number. The number required will be determined by the volume to be used for extraction.

4. Shake/invert the sample bottle to thoroughly mix the sample before pouring aliquot(s).

5. Pour sample from original bottle into centrifuge tubes. Cap tubes and centrifuge for 5 minutes at full speed (one full cycle).

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Version: <b>13</b>		Organisation level: <b>5-Sub-BU</b>
Approved by: <b>XL3S</b> Effective Date <b>16-JUN-2020</b>	Document users: <b>5_EUUSLA_PFAS_Manager,          6_EUUSLA_PFAS_Analyst,          6_EUUSLA_PFAS_Data_Reviewers,          6_EUUSLA_PFAS_Management_Team,          6_EUUSLA_PFAS_Sample_Prep</b>	Responsible: <b>5_EUUSLA_PFAS_Manager</b>

6. On a calibrated, top-loading balance, place labeled empty 250 mL PP wide-mouthed bottle.

7. Decant centrifuged sample aliquot(s) from centrifuge tube(s) to the 250 mL bottle until desired volume (weight in grams) is reached. 100 g = 100 mL, 50 g = 50 mL, etc. If the weight is exceeded, remove excess volume with a disposable pipette and discard to a waste container.

8. Add Milli-Q water to the bottle until a weight of 250 g (total of 250 mL) is reached.

9. Shake/invert several times to mix thoroughly.

10. Record the aliquot taken from the original bottle (50 mL, 100 mL) as the sample volume.

11. Extract sample beginning with Procedure B.

#### D. Samples Containing Dissolved and/or Settleable Solids

1. Spike sample with appropriate spikes as in Procedure B.5

2. Centrifuge the full bottle.

3. DO NOT SHAKE BOTTLE FOLLOWING THE CENTRIFUGE STEP.

4. Follow steps in Procedure B, 1 through 3.

5. Attach a 25-mL SPE reservoir to each cartridge. Decant centrifuged sample onto its respective SPE cartridge. Allow full volume to pass through each cartridge by gravity, if possible. Apply light vacuum if necessary. The drip rate should be approximately 1-2 drops per second.

6. Rinse the sample bottle with 5 mL of Milli-Q water, add the rinseate to the cartridge, and repeat.

7. Continue extraction process with Procedure B.7.

#### E. Preparation of non-aqueous liquid samples for analysis.



1. Determine if sample is miscible in MeOH.

a. Through e. – PROPRIETARY CONTENT

2. Through 4. – PROPRIETARY CONTENT

5. Add 25 µl of surrogate solution (ex.: SSMODX\_) to the 4 mL microcentrifuge tube. Vortex to mix thoroughly.

6. Transfer a 400 µl aliquot to a 9 mm LC analysis

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vial.

7. Add 20 µl of internal standard (ex: IS1927633A) to the LC vial. Vortex to mix thoroughly. Sample is ready for LC/MS/MS analysis.

F. Prepare the batch QC for non-aqueous liquid samples.

1. Method Blank Preparation:

- a. Pipette 975 µl of MeOH into a 4 mL microcentrifuge tube.
- b. Add 25 µl of surrogate solution(ex: SSMODX\_) to the 4 mL microcentrifuge tube. Vortex to mix thoroughly.
- c. Transfer a 400 µl aliquot to a 9 mm LC analysis vial.
- d. Add 20 µl of internal standard (ex: IS1927633A) to the LC vial. Vortex to mix thoroughly. Method Blank is ready for LC/MS/MS analysis.

2. LCS/LCSD Preparation:

- a. Pipette 935 µl of MeOH into a 4 mL microcentrifuge tube.
- b. Add 25 µl of surrogate solution(ex: SSMODX\_) to the 4 mL microcentrifuge tube.
- c. Add 40 µl of MS spiking solution (ex: MSMODWX\_) to the 4 mL microcentrifuge tube.
- d. Vortex to mix thoroughly.
- e. Transfer a 400 µl aliquot to a 9 mm LC analysis vial.
- f. Add 20µl of internal standard (ex: IS1927633A) to the LC vial.
- g. Vortex to mix thoroughly. LCS is ready for LC/MS/MS analysis.



G. LC/MS/MS Analysis

1. Mass Calibration and Tuning

a. At instrument set up and installation and after the performance of major maintenance, calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. The entire mass range must be calibrated.

b. When masses fall outside of the  $\pm 0.5$  amu of the true value, the instrument must be retuned using PPG according to the manufacturer's specifications. Mass assignments of the tuning standard must be within 0.5 amu of the true value. Refer to the instrument manufacturer's instructions for tuning.



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and conditions. These values are stored in the tune file for future reference.

2. The mass spectral acquisition rate must include a minimum of 10 spectra scans across each chromatographic peak. See the AB Sciex (4500/5500/5500 Plus) Acquisition, Quantitation, Gradient, and detector condition files for the most up to date chromatographic conditions. Modifications to these conditions can be made at the discretion of the analyst to improve resolution or the chromatographic process.

3. Acquisition method: PROPRIETARY CONTENT Mass Transitions: See [Attachment 1](#).

4. Load sample vials containing standards, quality control samples, and sample extracts into autosampler tray. Allow the instrument adequate time to equilibrate to ensure the mass spec and LC have reached operating conditions (approximately 5 minutes) before the first injection. Analyze several solvent blanks clean the instrument prior to sample acquisition.

5. After the initial calibration and when analyzing samples within the same tune, inject an instrument blank, followed by the ICV, Linear branched (L/B) standard, closing Cal3 level CCV, extraction batch QC, and samples. Bracket each set of ten samples with a CCV standard, alternating between the CAL2, CAL3, and CAL4 levels.

6. After injections are completed, check all CCV recoveries and absolute areas to make sure they are within method control limits. See Calibration section B.2 for acceptance criteria. Process each chromatogram and closely evaluate all integrations, baseline anomalies, and retention time differences. If manual integrations are performed, they must be documented and a reason given for the change in integrations. The manual integrations are documented during data processing and all original integrations are reported at the end of the sample PDF file with the reason for manual integration clearly listed.

7. Quantitate results for the extraction blank. No target analytes at or above the reporting limit may be found in the extraction blank for acceptable batch results. If a target analyte is detected in the extraction blank but not detected in the sample, the data is reported. If a target analyte is detected in the method blank at a concentration greater than the reporting limit and also in the sample, the sample must be reextracted. If the target analyte in the sample is detected at a concentration greater than 10 times the amount detected in the method blank, the data is reported.



8. Calculate the recoveries of spiked analytes for the LCS, matrix spike and matrix spike duplicate (MS/MSD) by comparing concentrations observed to the true values.

a. LCS, MS, extraction standard recoveries and RPDs are calculated and compared to the limits stored on the LIMS. See [Attachment 6](#) for requirements for samples from the state of Minnesota.

b. If LCS and/or LCSD recoveries are acceptable, proceed to sample quantitation.

c. If the LCS recoveries are above QC acceptance criteria and there are no detections for the compound(s) in the associated sample(s), the data can be reported with a qualifying comment. In all



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other cases, the samples associated with the LCS must be reextracted.

d. If MS/MSD recoveries are outside QC acceptance criteria, the associated data will be flagged or noted in the comments section of the report.

9. Isotopically-labeled extraction standards are added to all samples, extraction blank, LCS/LCSD, and MS/MSD prior to extraction. The recovery of the extraction standards should be within QC acceptance criteria. If the extraction standard recovery(ies) is(are) outside the QC limit(s), consult a supervisor to determine the appropriate course of action based on batch and sample results. See [Attachment 6](#) for requirements for samples from the state of Minnesota.

10. Isotopically-labeled injection standards are added to each QC and field sample extract prior to analysis. The absolute areas of the injection standards should be within 50-150% of the average areas measured during the initial calibration. If the internal standards are recovered outside 50-150%, consult a supervisor to determine the appropriate course of action based on batch and sample results.

11. Compare the retention times of all of the analytes, surrogates, and internal standards to the retention time from the initial calibration. The retention times should not vary from the expected retention time by more than



- a. 0.4 minutes for isotopically-labeled compounds
- b. 0.1 minutes from their analog for native compounds with an exact isotopically-labeled compound
- c. 0.4 minutes from their assigned analog for native compounds without an exact isotopically-labeled compound.

If the retention time is outside of the criteria, the compound is considered a false positive unless it is a compound with branched isomers. Compounds with branched isomers can vary in intensity of the individual isomers that are used for reporting and must be reviewed and compared to the preceding CCV to determine if it should be reported.

12. Two ion transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA, PFPeA, PFOSA, NMePFOSAE, NMePFOSA, NEtPFOSAE, and NEtPFOSA. The expected ion ratio for each compound is calculated by using the average of ion ratios of each compound from initial calibration standards. When an ion ratio for a compound differs from the expected ion ratio by more than 50%, a qualifier is placed on the raw data and on the sample report. No corrective action is required.

13. The linear/branch chain standard is used when assessing the correctness of the computer generated peak integrations for PFOA.

14. If the calculated concentration exceeds the calibration range of the system, determine the appropriate dilution required and dilute the extract with MeOH. If the sample dilution required exceeds 100 fold, the client must be contacted to determine if the data can be reported with result(s) that

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exceed the calibration range or if the sample should be re-prepped at a reduced volume.

Dilution Example 1/10: Mix 900 µl of MeOH with 100 µl of sample extract. Vortex to mix. Using an auto-pipette, transfer 400 µL of the mixed solution into a labeled auto-sampler vial containing a plastic insert. Using an auto-pipette, add 20 µL of labeled injection std to the 400 µL aliquot. Cap and vortex thoroughly to mix.

## Calculations

### A. Peak Area Ratio

$$\text{Peak Area Ratio} = \frac{\text{Analyte Response}}{\text{Labeled Analyte Response}}$$

### B. On-Column Analyte Concentration using linear through zero curves (MQ Data processing system)

On-column Concentration = (peak area ratio x Internal Standard concentration) ÷ slope

### C. Sample Concentration

Sample concentration (ng/l) = (On-column concentration x Final Sample volume x DF) ÷ Sample weight



### D. Ion Ratio

ion ratio = (peak area or height of quantifier)/(peak area or height of qualifier)

E. See [T-PEST-WI9847](#) for additional calculations used to evaluate the calibrations and quality control samples.

## Statistical Information/Method Performance

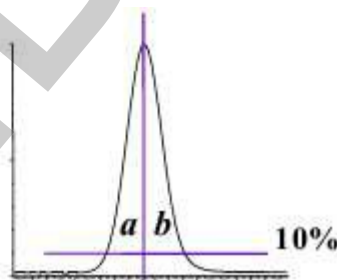
The LCS should contain all compounds of interest. LCS, MS, extraction standard recoveries and RPD are compared to the limits stored on the LIMS. These limits are statistically derived when sufficient data points are available. If sufficient data points are not available to generate statistical windows, an advisory window of 70% to 130% will be used. Historical data for MS/Ds, LCS/Ds, measurement of uncertainty, is reviewed at least annually. Reporting limits including method detection limits (MDLs) and limits of quantitation (LOQs) are set according to EPA method requirements and are evaluated annually. Refer to [QA-SOP11892](#) for specific guidelines and procedures. Updates to the LIMS are made as needed by the QA Department and only as directed by the supervisor.

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The initial demonstration of capability for this method has been carried out as listed below.

1. Initial Demonstration of Low System Background - Performed any time a new lot of SPE cartridges, solvents, centrifuge tubes, disposable pipets, and autosampler vials are used.
  - a. No peaks are present within the retention time window of any analyte that would prevent the determination of that analyte. If any peaks are present, determine the source of the contamination and eliminate the interference before sample analysis.
  - b. Background from method analytes must be below 1/3 of the MRL.
2. Initial Demonstration of Peak Asymmetry factor - Performed during the IDC and every time a new calibration curve is generated.
  - a. Calculate the peak asymmetry factors for the first two eluting peaks in a mid-level CAL standard using the following equation:

$$A_s = \frac{b}{a}$$





where:

$A_s$  = peak asymmetry factor

$B$  = width of the back half of the peak measured (at 10% peak height) from the trailing edge of the peak to a line dropped perpendicularly from the peak apex

$a$  = the width of the front half of the peak measured (at 10% peak height) from the leading edge of the peak to a line dropped perpendicularly from the apex.

- b. Peak asymmetry factors must fall in the range of 0.8 to 1.5.
  - c. If the criteria are not met, corrective action must be taken prior to sample analysis.
3. Minimum Reporting Level (MRL) confirmation
  - a. Fortify, extract, and analyze seven replicate LFBs at the proposed MRL concentration.

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- b. Calculate the mean measured concentration and standard deviation of the replicates.
- c. Determine the Half Range for the prediction interval of results ( $HR_{PIR}$ ) using the equation below:

$$HR_{PIR} = 3.963s$$

where

$s$  = the standard deviation

3.963 = a constant value for seven replicates.

- d. The Upper PIR limit must be  $\leq 150\%$  recovery using the equation below:

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

- e. The Lower PIR Limit must be  $\geq 50\%$  recovery using the equation below:



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

- f. The MRL is validated if both the Upper and Lower PIR limits meet the criteria
- g. If the criteria is not met, the MRL is too low and must be determined again at a higher concentration.

### Quality Assurance/Quality Control

For each batch of samples extracted, a method blank and an LCS/LCSD (Milli Q water spiked with all compounds to be determined carried through the entire procedure) must be extracted and analyzed. If an MS/MSD is submitted then an LCSD would not be extracted. A batch is defined as the samples to be extracted on any given day, but not to exceed 20 field samples. If more than 20 samples are prepared in a day, an additional batch must be prepared. If any client, state, or agency has more stringent QC or batching requirements, these must be followed.

Statistical control limits must be calculated for recoveries of LCS and MS when sufficient data points have been collected.

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QA-SOP11178 Demonstrations of Capability

QA-SOP11892 Determining Method Detection Limits and Limits of Quantitation

T-PEST-WI9847 Common Equations Used During Chromatographic Analyses

T-PFAS-WI13881 Standards Management in the PFAS Laboratory

Attachment: Attachment 1 - Mass Transitions (doc)

Attachment: Attachment 2 - Standard Relationships (docx)

Attachment: Attachment 3 - PROPRIETARY CONTENT

Attachment: Attachment 4 - Example Certificate of Analysis (pdf)

Attachment: Attachment 5 - PROPRIETARY CONTENT

Attachment: Attachment 6 - Requirements for Minnesota NPW samples and non-NPW samples (doc)

Attachment:

Attachment 1 - Mass Transitions

Attachment 2 - Standard Relationships

Attachment 3 - PROPRIETARY CONTENT

Attachment 4 - Example Certificate of Analysis

Attachment 5 - PROPRIETARY CONTENT

Attachment 6 - Requirements for Minnesota NPW samples and non-NPW samples

End of document

### Version history

Version	Approval	Revision information
11.1	25.SEP.2019	
12	15.OCT.2019	
13	01.JUN.2020	

## Attachment 1

### Mass Transitions AB Sciex 4500

Compound	Parent Ion	Daughter Ion
13C3-PFBA	216	172
13C4-PFBA	217	172
PFBA	213	169
13C5-PFPeA	268	223
PFPeA	263	219
13C3-PFBS	302	80
PFBS	299	80
PFBS (2)	299	99
13C2-4:2-FTS	329	81
4:2-FTS	327	307
4:2-FTS (2)	327	81
13C5-PFHxA	318	273
PFHxA	313	269
PFHxA (2)	313	119
PFPeS	349	80
PFPeS (2)	349	99
13C3-PFHxS	402	80
PFHxS	399	80
PFHxS (2)	399	99
13C4-PFHpA	367	322
PFHpA	363	319
PFHpA (2)	363	169
13C2-6:2-FTS	429	81
6:2-FTS	427	407
6:2-FTS (2)	427	81
PFHpS	449	80
PFHpS (2)	449	99
13C2-PFOA	415	370
13C8-PFOA	421	376
PFOA	413	369
PFOA (2)	413	169
13C4-PFOS	503	80
13C8-PFOS	507	80
PFOS	499	80
PFOS (2)	499	99
13C9-PFNA	472	427
PFNA	463	419

## Attachment 1

Compound	Parent Ion	Daughter Ion
PFNA (2)	463	169
13C8-PFOSA	506	78
PFOSA	498	78
PFNS	549	80
PFNS (2)	549	99
13C2-PFDA	515	470
13C6-PFDA	519	474
PFDA	513	469
PFDA (2)	513	169
13C2-8:2-FTS	529	81
8:2-FTS	527	507
8:2-FTS (2)	527	81
d7-NMePFOSAE	623	59
NMePFOSAE	616	59
d3-NMePFOSA	515	169
NMEPFOSA	512	169
d3-NMeFOSAA	573	419
NMeFOSAA	570	419
NMeFOSAA (2)	570	483
d9-NEtPFOSAE	639	59
NEtPFOSAE	630	59
d5-NETPFOSA	531	169
NEtPFOSA	526	169
PFDS	599	80
PFDS (2)	599	99
13C7-PFUnDA	570	525
PFUnDA	563	519
PFUnDA (2)	563	169
d5-NEtFOSAA	589	419
NEtFOSAA	584	419
NEtFOSAA (2)	584	526
13C2-PFDoDA	615	570
PFDoDA	613	569
PFDoDA (2)	613	169
10:2-FTS	627	607
10:2-FTS (2)	627	81
PFDoS	699	80
PFDoS (2)	699	99
PFTrDA	663	619
PFTrDA (2)	663	169



## Attachment 1

Compound	Parent Ion	Daughter Ion
13C2-PFTeDA	715	670
PFTeDA	713	669
PFTeDA (2)	713	169
PFHxDA	813	769
PFHxDA (2)	813	169
PFODA	913	869
PFODA (2)	913	169
13C3-HFPODA	332	287
HFPODA	329	285
HFPODA (2)	329	169
DONA	377	251
DONA (2)	377	85
9Cl-PF3ONS	531	351
9Cl-PF3ONS (2)	531	83
11Cl-PF3OUdS	631	451
11Cl-PF3OUdS (2)	631	99

## Attachment 2

### PFAS Injection Standards/Extraction Standards/Native Compounds

#### Injection Standards

Inj Std	Internal Standard/Injection Standard
I13C3-PFBA	13C3-PFBA
I13C2-PFOA	13C2-PFOA
I13C4-PFOS	13C4-PFOS
I13C2-PFDA	13C2-PFDA

#### Extraction Standards

Extraction Standard	Internal Standard
E13C4-PFBA	13C3-PFBA
E13C5-PFPeA	
E13C3-PFBS	
E13C2-4:2-FTS	13C2-PFOA
E13C5-PFHxA	
E13C3-PFHxS	
E13C4-PFHpA	
E13C2-6:2-FTS	
E13C8-PFOA	
13C3-HFPODA	
E13C8-PFOS	13C4-PFOS
E13C9-PFNA	

Extraction Standard	Internal Standard
E13C8-PFOSA	13C2-PFDA
E13C6-PFDA	
E13C2-8:2-FTS	
Ed7-NMePFOSAE	
Ed3-NMePFOSA	
Ed3-NMeFOSAA	
Ed9-NEtPFOSAE	
Ed5-NEtPFOSA	
E13C7-PFUnDA	
Ed5-NEtFOSAA	
E13C2-PFDoDA	
E13C2-PFTeDA	

#### Native PFAS Compounds

Native	Extraction Standard
PFBA	13C4-PFBA
PFPeA	13C5-PFPeA
PFBS	13C3-PFBS
PFPeS	
4:2-FTS	13C2-4:2-FTS
PFHxA	13C5-PFHxA
PFHxS	13C3-PFHxS
PFHpS	
PFHpA	13C4-PFHpA
DONA	
6:2-FTS	13C2-6:2-FTS
PFOA	13C8-PFOA

Native	Extraction Standard
PFOS	13C8-PFOS
PFNS	
PFDS	
9Cl-PF3ONS	
11Cl-pf3OUdS	
PFDoS	
PFNA	13C9-PFNA
PFOSA	13C8-PFOSA
PFDA	13C6-PFDA
8:2-FTS	13C2-8:2-FTS
10:2-FTS	
NMePFOSAE	d7-NMePFOSAE
NMePFOSA	d3-NMePFOSA
NMeFOSAA	d3-NMeFOSAA
NEtPFOSAE	d9-NEtPFOSAE
NEtPFOSA	d5-NEtPFOSA
PFUnDA	13C7-PFUnDA
NEtFOSAA	d5-NEtFOSAA
PFDODA	13C2-PFDODA
PFTTrDA	
PFTeDA	13C2-PFTeDA
PFHxDA	
PFODA	
HFPODA	13C3-HFPODA

**WELLINGTON**  
LABORATORIES**CERTIFICATE OF ANALYSIS**  
DOCUMENTATION**PFAC-MXC****Native Perfluorinated  
Compound Solution/Mixture****PRODUCT CODE:**

PFAC-MXC

**LOT NUMBER:**

PFACMXC0617

**SOLVENT(S):**

Methanol / Water (&lt;1%)

**DATE PREPARED:** (mm/dd/yyyy)

06/14/2017

**LAST TESTED:** (mm/dd/yyyy)

03/19/2019

**EXPIRY DATE:** (mm/dd/yyyy)

03/19/2024

**RECOMMENDED STORAGE:**

Store ampoule in a cool, dark place

**DESCRIPTION:**

PFAC-MXC is a solution/mixture of thirteen native perfluoroalkylcarboxylic acids ( $C_4$ - $C_{14}$ ,  $C_{16}$ , and  $C_{18}$ ) and eight native perfluoroalkylsulfonates ( $C_4$ - $C_{10}$  and  $C_{12}$ ). The full name, abbreviation and concentration for each of the components are given in Table A.

The individual perfluoroalkylcarboxylic acids and perfluoroalkylsulfonates all have chemical purities of >98%.

**DOCUMENTATION/ DATA ATTACHED:**

Table A: Components and Concentrations of the Solution/Mixture

Figure 1: LC/MS Data (SIR)

Figure 2: LC/MS/MS Data (Selected MRM Transitions)

**ADDITIONAL INFORMATION:**

- See page 2 for further details.
- Contains 4 mole eq. of NaOH to prevent conversion of the carboxylic acids to their respective methyl esters.

**FOR LABORATORY USE ONLY: NOT FOR HUMAN OR DRUG USE**

Wellington Laboratories Inc., 345 Southgate Dr. Guelph ON N1G 3M5 CANADA  
519-822-2436 • Fax: 519-822-2849 • [info@well-labs.com](mailto:info@well-labs.com)



## ATTACHMENT 4

### **INTENDED USE:**

The products prepared by Wellington Laboratories Inc. are for laboratory use only. This certified reference material (CRM) was designed to be used as a standard for the identification and/or quantification of the specific chemical compounds it contains.

### **HANDLING:**

This product should only be used by qualified personnel familiar with its potential hazards and trained in the handling of hazardous chemicals. Due care should be exercised to prevent unnecessary human contact or ingestion. All procedures should be carried out in a well-functioning fume hood and suitable gloves, eye protection, and clothing should be worn at all times. Waste should be disposed of according to national and regional regulations. Safety Data Sheets (SDSs) are available upon request.

### **SYNTHESIS / CHARACTERIZATION:**

Our products are synthesized using single-product unambiguous routes whenever possible. They are then characterized, and their structures and purities confirmed, using a combination of the most relevant techniques, such as NMR, GC/MS, LC/MS/MS, SFC/UV/MS/MS, x-ray crystallography, and melting point. Isotopic purities of mass-labelled compounds are also confirmed using HRGC/HRMS and/or LC/MS/MS.

### **HOMOGENEITY:**

Prior to solution preparation, crystalline material is tested for homogeneity using a variety of techniques (as stated above) and its solubility in a given diluent is taken into consideration. Duplicate solutions of a new product are prepared from the same crystalline lot and, after the addition of an appropriate internal standard, they are compared by GC/MS, LC/MS/MS, and/or SFC/UV/MS/MS. The relative response factors of the analyte of interest in each solution are required to be <5% RSD. New solution lots of existing products, as well as mixtures and calibration solutions, are compared to older lots in a similar manner. This further confirms the homogeneity of the crystalline material as well as the stability and homogeneity of the solutions in the storage containers. In order to maintain the integrity of the assigned value(s), and associated uncertainty, the dilution or injection of a subsample of this product should be performed using calibrated measuring equipment.

### **UNCERTAINTY:**

The maximum combined relative standard uncertainty of our reference standard solutions is calculated using the following equation:

The combined relative standard uncertainty,  $u_c(y)$ , of a value  $y$  and the uncertainty of the independent parameters

$x_1, x_2, \dots, x_n$  on which it depends is:

$$u_c(y(x_1, x_2, \dots, x_n)) = \sqrt{\sum_{i=1}^n u(y, x_i)^2}$$

where  $x$  is expressed as a relative standard uncertainty of the individual parameter.

The individual uncertainties taken into account include those associated with weights (calibration of the balance) and volumes (calibration of the volumetric glassware). An expanded maximum combined percent relative uncertainty of  $\pm 5\%$  (calculated with a coverage factor of 2 and a level of confidence of 95%) is stated on the Certificate of Analysis for all of our products.

### **TRACEABILITY:**

All reference standard solutions are traceable to specific crystalline lots. The microbalances used for solution preparation are regularly calibrated by an external ISO/IEC 17025 accredited laboratory. In addition, their calibration is verified prior to each weighing using calibrated external weights traceable to an ISO/IEC 17025 accredited laboratory. All volumetric glassware used is calibrated, of Class A tolerance, and traceable to an ISO/IEC 17025 accredited laboratory. For certain products, traceability to international interlaboratory studies has also been established.

### **EXPIRY DATE / PERIOD OF VALIDITY:**

Ongoing stability studies of this product have demonstrated stability in its composition and concentration, until the specified expiry date, in the unopened ampoule. Monitoring for any degradation or change in concentration of the listed analyte(s) is performed on a routine basis.

### **LIMITED WARRANTY:**

At the time of shipment, all products are warranted to be free of defects in material and workmanship and to conform to the stated technical and purity specifications.

### **QUALITY MANAGEMENT:**

This product was produced using a Quality Management System registered to the latest versions of ISO 9001 by SAI Global, ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA; A 1226), and ISO 17034 by ANSI-ASQ National Accreditation Board (ANAB; AR-1523).



\*\*For additional information or assistance concerning this or any other products from Wellington Laboratories Inc., please visit our website at [www.well-labs.com](http://www.well-labs.com) or contact us directly at [info@well-labs.com](mailto:info@well-labs.com)\*\*




# ATTACHMENT 4

**Table A: PFAC-MXC; Components and Concentrations (ng/ml,  $\pm$  5% in Methanol / Water (<1%))**

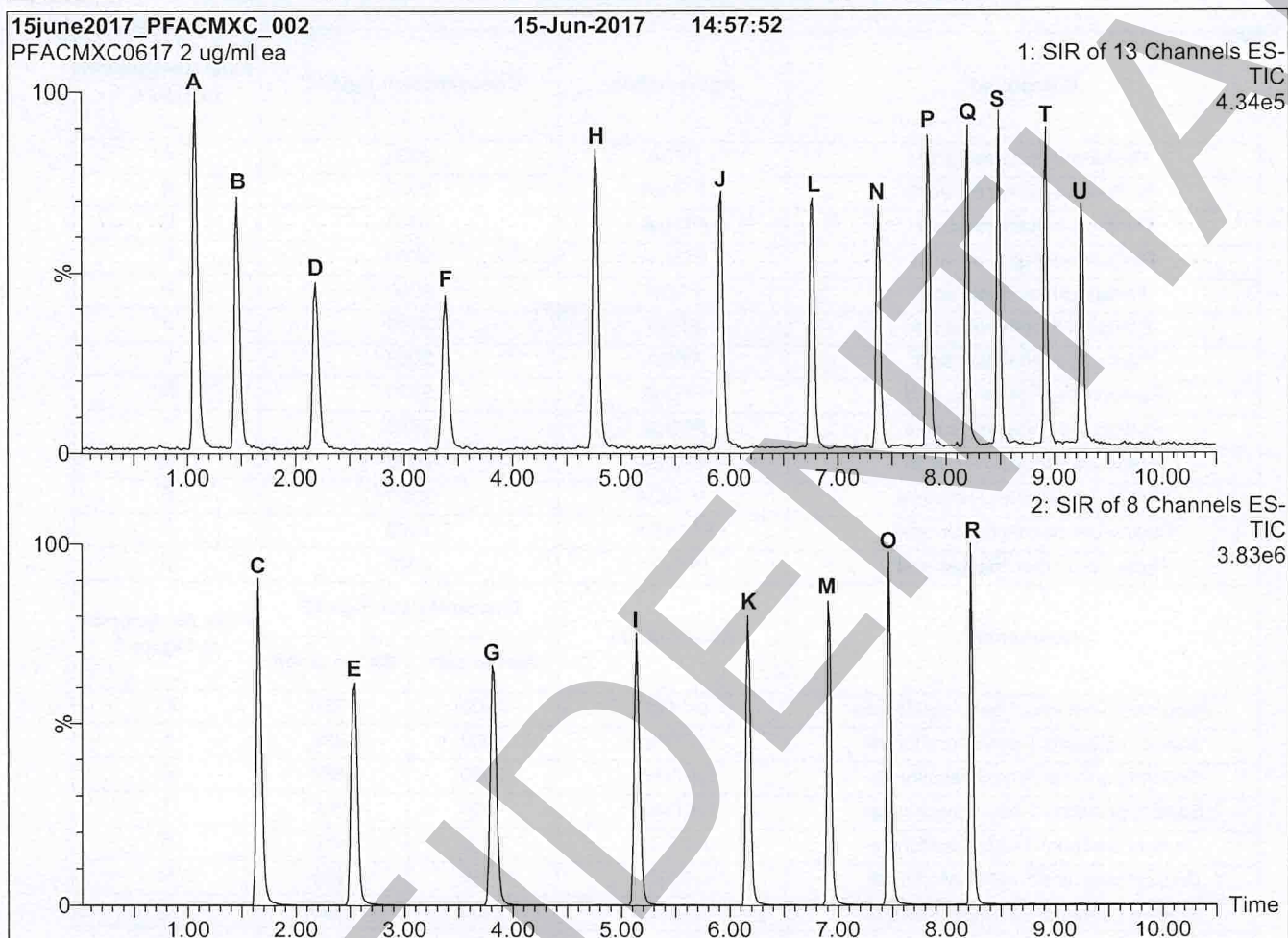
Compound	Abbreviation	Concentration (ng/ml)*		Peak Assignment in Figure 1
Perfluoro-n-butanoic acid	PFBA	2000		A
Perfluoro-n-pentanoic acid	PFPeA	2000		B
Perfluoro-n-hexanoic acid	PFHxA	2000		D
Perfluoro-n-heptanoic acid	PFHpA	2000		F
Perfluoro-n-octanoic acid	PFOA	2000		H
Perfluoro-n-nonanoic acid	PFNA	2000		J
Perfluoro-n-decanoic acid	PFDA	2000		L
Perfluoro-n-undecanoic acid	PFUDa	2000		N
Perfluoro-n-dodecanoic acid	PFDoA	2000		P
Perfluoro-n-tridecanoic acid	PFTTrDA	2000		Q
Perfluoro-n-tetradecanoic acid	PFTeDA	2000		S
Perfluoro-n-hexadecanoic acid	PFHxDA	2000		T
Perfluoro-n-octadecanoic acid	PFODA	2000		U
Compound	Abbreviation	Concentration (ng/ml)*		Peak Assignment in Figure 1
		As the salt	As the anion	
Potassium perfluoro-1-butanedisulfonate	L-PFBS	2000	1770	C
Sodium perfluoro-1-pentadisulfonate	L-PFPeS	2000	1880	E
Sodium perfluoro-1-hexadisulfonate	L-PFHxS	2000	1890	G
Sodium perfluoro-1-heptadisulfonate	L-PFHpS	2000	1900	I
Sodium perfluoro-1-octadisulfonate	L-PFOS	2000	1910	K
Sodium perfluoro-1-nonadisulfonate	L-PFNS	2000	1920	M
Sodium perfluoro-1-decadisulfonate	L-PFDS	2000	1930	O
Sodium perfluoro-1-dodecadisulfonate	L-PFDoS	2000	1940	R

\* Concentrations have been rounded to three significant figures.

Certified By:   
B.G. Chittim, General Manager

Date: 06/06/2019  
(mm/dd/yyyy)



**Figure 1:** PFAC-MXC; LC/MS Data (Total Ion Current Chromatogram; SIR)**Conditions for Figure 1:**

**LC:** Waters Acquity Ultra Performance LC  
**MS:** Micromass Quattro *micro* API MS

**Chromatographic Conditions**

Column: Acquity UPLC BEH Shield RP<sub>18</sub>  
 1.7  $\mu$ m, 2.1 x 100 mm

Mobile phase: Gradient

Start: 50% H<sub>2</sub>O / 50% (80:20 MeOH:ACN)  
 (both with 10 mM NH<sub>4</sub>OAc buffer)  
 Ramp to 90% organic over 8 min and hold for 2 min  
 before returning to initial conditions in 1 min.

Time: 12 min

Flow: 300  $\mu$ l/min

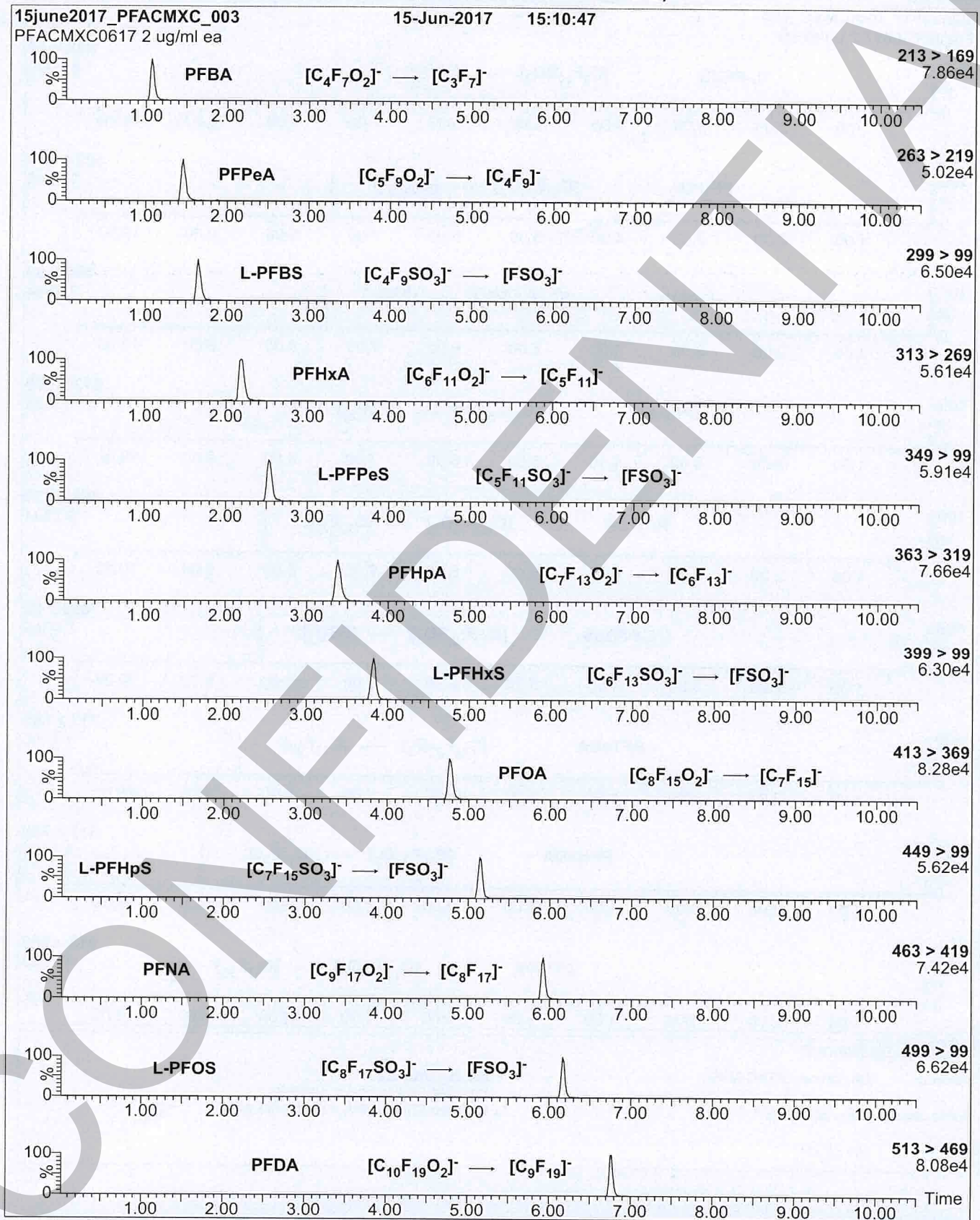
**MS Parameters**

Experiment: SIR of 21 Channels

Source: Electrospray (negative)  
 Capillary Voltage (kV) = 3.00  
 Cone Voltage (V) = variable (10-80)  
 Cone Gas Flow (l/hr) = 50  
 Desolvation Gas Flow (l/hr) = 750

# ATTACHMENT 4

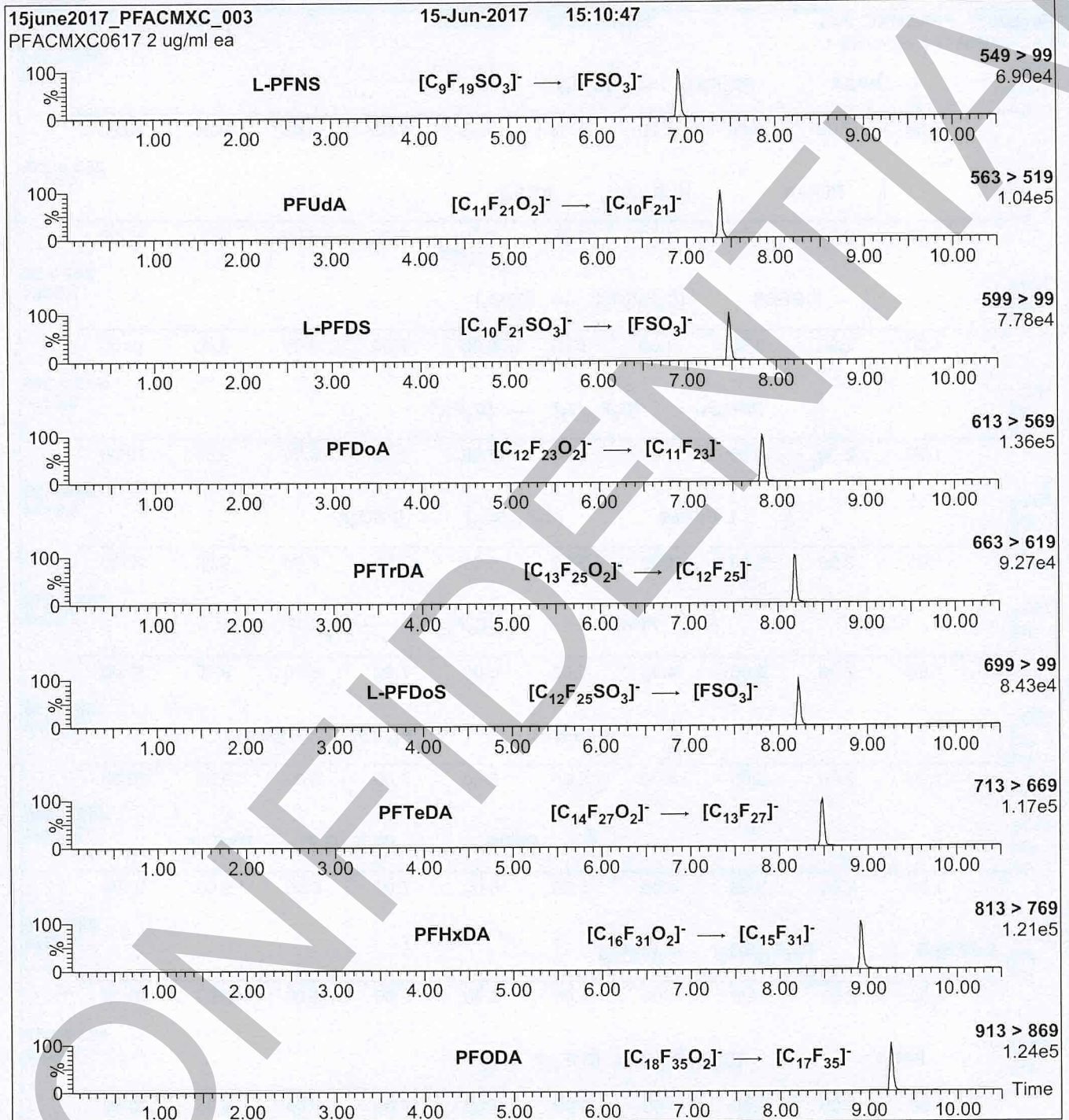
**Figure 2: PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**





# ATTACHMENT 4

**Figure 2: PFAC-MXC; LC/MS/MS Data (Selected MRM Transitions)**



**Conditions for Figure 2:**

Injection: On-column (PFAC-MXC)

Mobile phase: Same as Figure 1

Flow: 300  $\mu$ l/min

**MS Parameters**

Collision Gas (mbar) = 3.46e-3

Collision Energy (eV) = 8-50 (variable)

## Attachment 6

### Requirements for Minnesota NPW samples and non-NPW samples

- A. Initial Calibration criteria
  - 1. %RSD  $\leq$  20% for all analytes.
  - 2. Low point of the curve – %D 70-130%, all other points 75-125%
- B. Continuing Calibration criteria
  - 1. All CCVs are analyzed at mid-level of initial calibration curve
  - 2. %D(difference) must be  $\pm$  30% of the true value
  - 3. If the %D is  $>$  +30%, and the target is not detected in the sample, the data can be used with an appropriate qualifier.
- C. QC Recovery - isotopically labeled compounds
  - Isotope dilution labeled recoveries 50-200%
- D. Batch and Matrix QC acceptance criteria
  - 1. LCS/LCSD
    - a. Spike concentrations must be 5-10X the reporting limits
    - b. LCS/LCSD Recovery 80-120% for all native compounds for NPW samples
    - c. LCS/LCSD Recovery 60-130% for all native compounds for non NPW matrices
    - d. LCS/LCSD RPD  $\leq$  20% for NPW samples
    - e. LCS/LCSD RPD  $\leq$  50% for non NPW matrices
  - 2. MS/MSD
    - a. Spike concentrations must be 5-10X the reporting limits.
    - b. MS/MSD recovery 70-130% for all native compounds for NPW samples
    - c. MS/MSD Recovery 50-150% for all native compounds for non NPW matrices
    - d. MS/MSD RPD  $\leq$  30% for NPW samples
    - e. MS/MSD RPD  $\leq$  50% for non NPW matrices

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX A**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

---

**ATTACHMENT B**

Chain of Custody Form



702 Electronic Drive      Phone: 215-355-3900  
Horsham, PA 19044-0962      Fax: 215-355-7231

Client/Acct. No. \_\_\_\_\_  
Address \_\_\_\_\_  
City/State/Zip \_\_\_\_\_  
Phone/Fax \_\_\_\_\_  
Client Contact: \_\_\_\_\_

CHAIN OF CUSTODY  
Page \_\_\_\_ of \_\_\_\_

Bill to/Report to (if different)

Sampling Site Address (if different) Include State

P.O. No.

PWSID #:

Quote #

e-mail:

Lab LIMS No:

LAB USE ONLY:

# \_\_\_\_ Ascorbic/HCL Vials    # \_\_\_\_ HCl Vials

# \_\_\_\_ Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> \_\_\_\_\_

# \_\_\_\_ Na OH/Zn acetate pH \_\_\_\_\_

# \_\_\_\_ HNO<sub>3</sub> pH \_\_\_\_\_

# \_\_\_\_ H<sub>2</sub>SO<sub>4</sub> pH \_\_\_\_\_

# \_\_\_\_ NaOH pH \_\_\_\_\_

# \_\_\_\_ Unpreserved

# \_\_\_\_ HCl    # \_\_\_\_ NH<sub>4</sub>Cl    # \_\_\_\_ MeOH

# \_\_\_\_ DI Water

ANALYSIS REQUESTED

MATRIX CODES

DW: DRINKING WATER

GW: GROUND WATER

WW: WASTEWATER

SO: SOIL

SL: SLUDGE

OIL: OIL

SOL: NON SOIL SOLID

MI: MISCELLANEOUS

X: OTHER

Field pH, Temp (°C),  
DO, Cl<sub>2</sub>, Cond. etc.

LAB USE ONLY	PROJECT	Collection		G R A B	C O M P	Matrix Code	Number of Containers									
	FIELD ID	Date	Military Time				Total	H 2 S O 4	H C l	V i a l s	H N O 3	N a O H	Z n A c	U N P R E	B A C T	

SAMPLED BY: (Name/Company)	TAT: <input type="checkbox"/> STANDARD (10 DAY)	Report Format: <input type="checkbox"/> Standard <input type="checkbox"/> NJ-RDD <input type="checkbox"/> SRP-RDD <input type="checkbox"/> Standard + QC <input type="checkbox"/> Forms <input type="checkbox"/> EDD	Field Parameters Analyzed By:	
	or DUE DATE ____/____/____		Initials	Date/Time:
	Please call for pricing and availability for rush (<10 day) turnaround and for all but standard reporting format.			

SAMPLE CUSTODY EXCHANGES MUST BE DOCUMENTED BELOW. USE FULL LEGAL SIGNATURE, DATE AND MILITARY TIME (24 HOUR CLOCK, I.E. 8AM IS 0800, 4 PM IS 1600)

RELINQUISHED BY SAMPLER	DATE	TIME	RECEIVED BY	DATE	TIME	DELIVERY: <input type="checkbox"/> EQC COURIER <input type="checkbox"/> CLIENT <input type="checkbox"/> UPS <input type="checkbox"/> FEDEX <input type="checkbox"/> OTHER _____	Custody Seal Number
1.			1.			Rec'd Temp.: _____ Initials: _____ Ice Y / N    Location: _____  COMMENTS:   Hazardous: yes / no	
RELINQUISHED BY 2.	DATE	TIME	RECEIVED BY 2.	DATE	TIME		
RELINQUISHED BY 3.	DATE	TIME	RECEIVED BY 3.	DATE	TIME		
RELINQUISHED BY 4.	DATE	TIME	RECEIVED BY 4.	DATE	TIME		
RELINQUISHED BY 5.	DATE	TIME	RECEIVED BY 5.	DATE	TIME		



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

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX B**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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## **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.

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX B**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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**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.

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX B**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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**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.

**REMEDIAL INVESTIGATION WORK PLAN  
PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)  
BROOKLYN, NEW YORK 11209**

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**APPENDIX C  
Health and Safety Plan**

**SITE-SPECIFIC HEALTH AND SAFETY PLAN**

**FOR**

**REMEDIAL INVESTIGATION**

**OF**

**PROPOSED PUBLIC SCHOOL FACILITY K20F**

**8802 5th Avenue and 429 89th Street**

**Brooklyn, New York 11209**

**BLOCK 6065, LOTS 28 AND 39**

**NYSDEC Brownfield Cleanup Program Site No. C224327**

**Prepared by:**

**TRC Engineers, Inc.  
1430 Broadway, 10<sup>th</sup> Floor  
New York, New York 10018**

**TRC Project Number 435632**

**March 2022**



**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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**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.

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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**FIGURES**

Figure 1 – Site Location Map  
Figure 2 – Proposed Sampling Locations

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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**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  
Attachment I – Safe Catch Form  
Attachment J – COVID-19 Guidelines for Field Activities

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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## **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 proposed Public School Facility K20F, located at 8802 5th Avenue and 429 89th Street, Brooklyn, New York 11209 (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 encompasses approximately 31,659 square feet (sf) and is improved with a one-story commercial building with a basement and an asphalt-paved parking lot on Lot 28 (8802 5th Avenue), and a commercial building with a partial basement on Lot 39 (429 89th Street). Lot 28 is approximately 21,659 sf and contains a one-story commercial building with a gross floor area of approximately 13,835 sf that is currently subdivided into two units which are currently vacant. Lot 39 is approximately 10,000 sf and is improved with a one-story commercial building with a partial basement that is currently vacant and was most recently used by a construction company for storage of tiles and other assorted construction materials.

TRC conducted environmental due diligence activities at the Site between 2019 and 2020. Based on the results of due diligence activities, elevated concentrations of chlorinated and petroleum related volatile organic compounds (VOCs) are present in soil vapor, and VOCs, semivolatile organic compounds (SVOCs), and metals are present in soil/sediment and groundwater. Two anomalies representative of potential underground storage tanks (USTs) were also identified at the Site.

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## 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 (68th Precinct (718) 439-4211)**

Hospital: **NYU Langone Hospital Emergency Room**

Emergency Center No.: **(718) 630-7185**

Hospital Address: **150 55<sup>th</sup> Street, Brooklyn, NY 11220**

### 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: Lindsay O'Hara  
Office/Division: New York City  
Office Phone: 917-809-9372  
Cell Phone: 914-420-9649

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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



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## 4.0 HAZARD ASSESSMENT

### 4.1 Contaminants of Concern

The analytical results of soil samples detected one (1) VOC (total xylenes) which was attributed to historic Site uses. SVOCs and metals were detected above comparison criteria in shallow soil samples (i.e., samples collected from 1 to 4 feet below ground surface) and were attributed to the characteristics of fill material at the Site. One VOC (cis-1,2-DCE), several SVOCs, and several metals were detected in sediment samples at concentrations exceeding comparison criteria, which were attributed to historic on-Site operations.

Petroleum- and chlorinated solvent-related compounds were detected in soil vapor and sub-slab vapor above screening criteria.

The analytical results of groundwater samples detected chloroform at concentrations slightly above comparison criteria, which was attributed to historic on-Site operations (i.e., leaking water pipes). Benzene, toluene, ethylbenzene, and xylenes (BTEX)-compounds, and phenol were detected in one (1) groundwater sample at concentrations above comparison criteria, which were attributed to historic on-Site operations or an off-Site source. Three (3) metals (antimony, lead, and manganese) were detected in filtered groundwater at concentrations above comparison criteria which were attributed to the characteristics of Site soil/fill.

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**.

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## 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.

The 2019 novel coronavirus, or COVID-19, is a new respiratory virus first identified in Wuhan, Hubei Province, China. It's called a "novel" — or new — coronavirus, because it is a coronavirus that has not been previously identified. Use the following precautions to avoid contracting COVID-19:

- Social distancing (at least 6 feet away from other individuals),
- Hand hygiene,
- Cover mouth and nose when coughing or sneezing,
- Avoid touching eyes, nose, or mouth,
- Frequently disinfect areas that are likely to have frequent hand contact.

See **Attachment J** for TRC Document No. CP052.1, COVID-19 Guidelines for Field Activities.

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#### **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**

<b>HAZARD TYPE</b>	<b>KNOWN</b>	<b>POTENTIAL</b>
Heat Stress/Cold Stress		<b>X</b>
Severe Weather (lightning, snow, sleet)		<b>X</b>
Excessive Noise	<b>X</b>	
Facility Operations (machinery, structures)		<b>X</b>
Unstable ground (wet and/or icy areas)		<b>X</b>
Site Operations (Excavation, drilling, hand and power tool use)	<b>X</b>	
Heavy lifting/moving	<b>X</b>	
Hazardous materials use & storage		<b>X</b>
Fire		<b>X</b>
Slips, trips, and falls	<b>X</b>	
Cuts, punctures	<b>X</b>	

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.

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- 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.
  - 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:

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- 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 previously identified. An update of utility mark-outs by the NYC One-Call Center will be conducted prior to subsurface work and a geophysical survey will be performed to confirm the proposed sampling locations are cleared of underground utilities.
- 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.
- 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.

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## **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***

Respiratory protection in the form of a face covering (N95, half face, or other cloth covering) will be required during implementation of the work plan in response to COVID-19.

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.

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## **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:

<b>Level D Personal Protective Equipment</b>	
<b>Item</b>	<b>Rationale/Notes</b>
<b>Hardhat</b>	Appropriately rated hard hats will be worn by personnel for protection against overhead hazards, including electrical.
<b>Hearing protection</b>	Hearing protection will be worn by all personnel exposed to more than 85 dB of sound during the workday.
<b>Safety boots</b>	Safety boots will be worn by all personnel during project work described in this HASP and at all times on site.
<b>Eye protection (safety glasses)</b>	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.
<b>Safety vest</b>	Utilize in areas in or near vehicular traffic of any kind on or off property.
<b>Gloves</b>	Gloves to be changed between samples to avoid cross-contamination. Nitrile chemically resistant gloves will be worn when handling sample bottles.
<b>Kevlar work gloves</b>	As indicated herein, use Cut and Abrasion Resistance Level 4 or Level 5 gloves when necessary for hand protection during field tasks.
<b>Face Covering</b>	As required in response to COVID-19, personnel will wear a face covering (N95, half face, or other cloth covering).

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.

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## **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.

<b>PERSONNEL DECONTAMINATION PROCEDURES FOR LEVEL D PROTECTION</b>	
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

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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 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.

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## **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:

<b>Project Training Requirements</b>				
(* 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 <sup>1</sup>	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 <sup>2</sup>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Defensive Driving	N/A	White Paper <sup>3</sup> TRC Manual <sup>4</sup>
Client-specific training: <span style="float: right;"><input type="checkbox"/> Not Applicable <input type="checkbox"/> Specify</span>				
Client-specific training: <span style="float: right;"><input type="checkbox"/> Not Applicable <input type="checkbox"/> Specify</span>				
Client-specific training: <span style="float: right;"><input type="checkbox"/> Not Applicable <input type="checkbox"/> Specify</span>				
<b>Note:</b>  * The on-site Health and Safety Officer shall have OSHA 8-hour supervisor training, in addition to 40-hour HAZWOPER.  <sup>1</sup> 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.  <sup>2</sup> TRC RMD Hand Protection Policy, August 2012  <sup>3</sup> Guidelines for Employers to Reduce Motor Vehicle Crashes (joint white paper by NETS, NHTSA and OSHA)  <sup>4</sup> 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.

<b>Medical Surveillance Required</b>			
*Baseline is minimum recommended.			
	<b>29 CFR 1910</b>	<b>29 CFR 1926 or Other</b>	<b>Notes</b>
<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 <sup>1</sup>	<input checked="" type="checkbox"/> Not Applicable <input type="checkbox"/> Specify		
Client-specific medical monitoring <sup>1</sup>	<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:

<sup>1</sup> 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.

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## **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.



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### 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 using the TRC General Project Safety Audit in the iAuditor application or the paper 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. Safe Catch Reports will be documented in the Intalex application or the paper form included in **Attachment I**.

REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C  
PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)  
BROOKLYN, NEW YORK 11209

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## **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.

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C  
PROPOSED PUBLIC SCHOOL FACILITY K20F  
8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)  
BROOKLYN, NEW YORK 11209**

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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.

**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C**  
**PROPOSED PUBLIC SCHOOL FACILITY K20F**  
**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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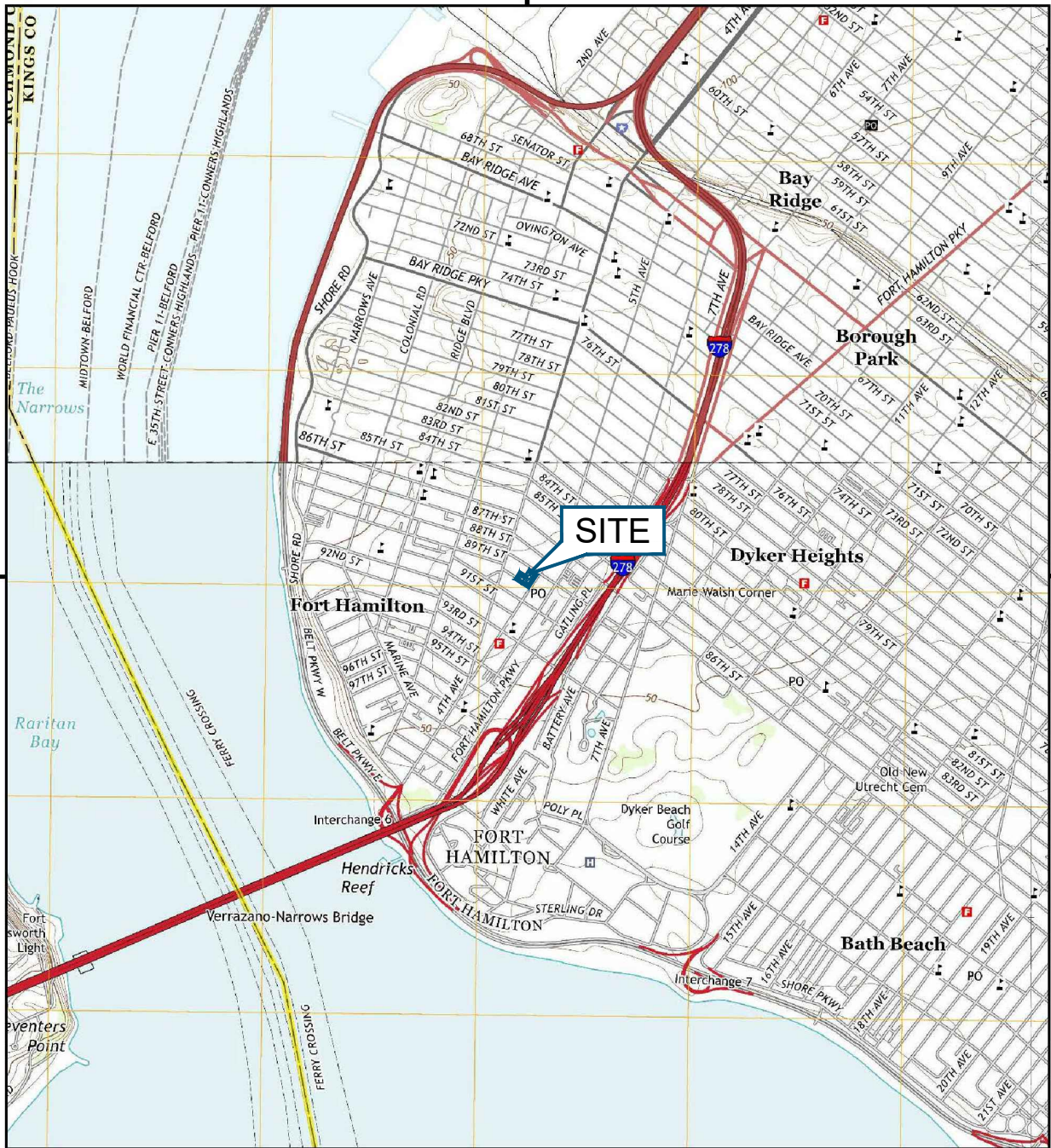
## **16.0 SUBCONTRACTORS AND HEALTH AND SAFETY PLANNING**

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.

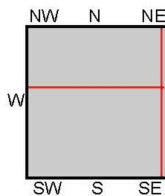
**REMEDIAL INVESTIGATION WORK PLAN – APPENDIX C**  
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**8802 5TH AVENUE AND 429 89TH STREET (BLOCK 6065, LOTS 28 AND 39)**  
**BROOKLYN, NEW YORK 11209**

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## **Figures**



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



TP, The Narrows, 2013, 7.5-minute  
N, Jersey City, 2014, 7.5-minute  
NE, Brooklyn, 2013, 7.5-minute  
SE, Coney Island, 2013, 7.5-minute



SITE NAME: 8802 5th Avenue  
ADDRESS: 8802 5th Avenue  
Brooklyn, NY 11209



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

PROJECT:  
**NEW YORK CITY SCHOOL CONSTRUCTION AUTHORITY**  
**8802 5TH AVENUE AND 429 89TH STREET**  
**BLOCK: 6065, LOTS: 28 & 39**  
**BROOKLYN, NEW YORK 11209**

TITLE:

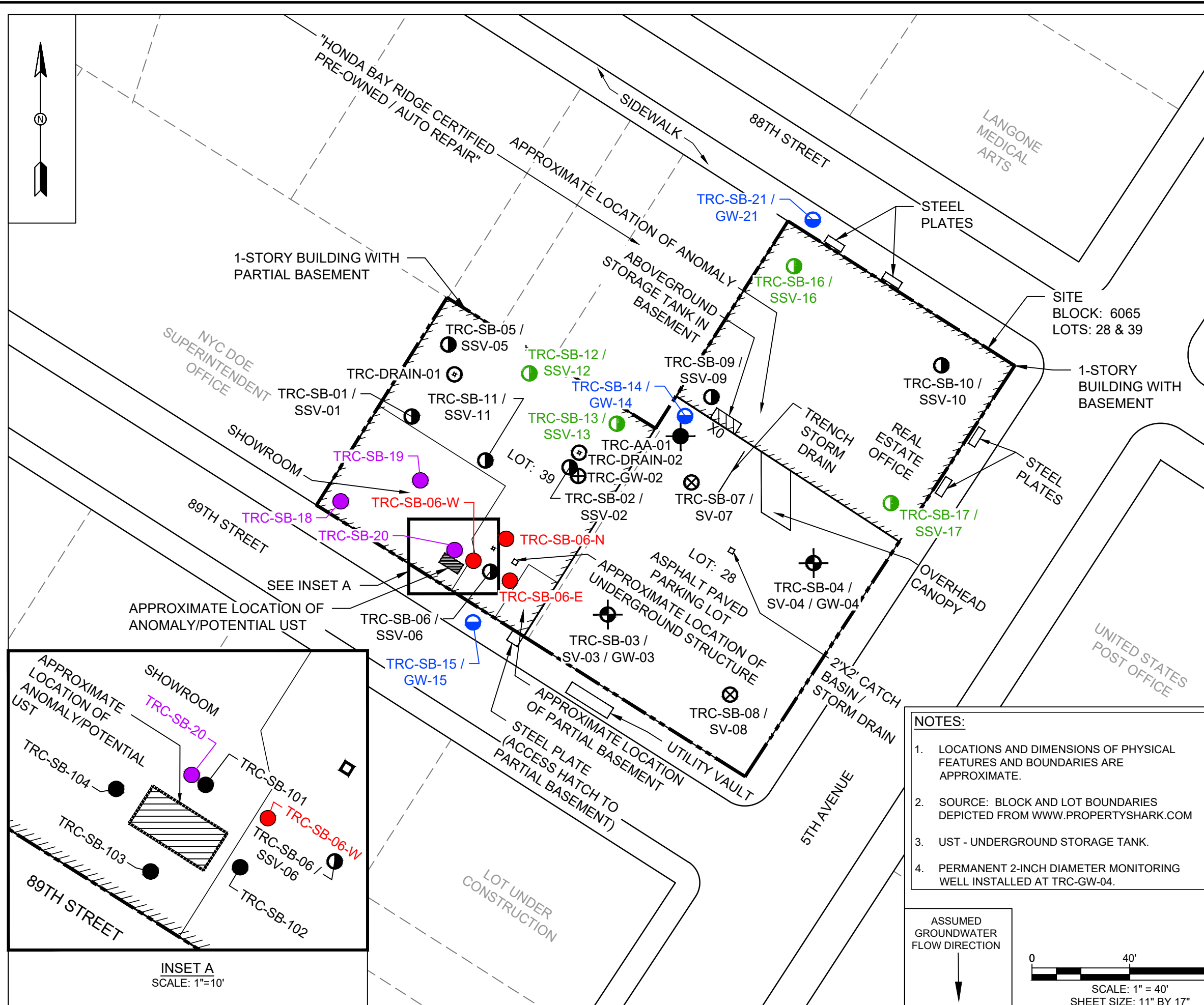
**SITE LOCATION MAP**

DRAWN BY: H. DELGADO  
CHECKED BY: L. O'HARA  
APPROVED BY: J. MIRANDA  
DATE: APRIL 2021  
PROJ. NO.: 435632  
FILE: Figure IV-2 - Site Location Map (K20F).dwg

**FIGURE 1**



11x17 - ATTACHED REFERENCE: 8802 8802 5th Avenue map, image; DRAWING NAME: \\nycc-fp-1\environmental\Shared\Projects\NYCSCA Contract C0000153484\35632 - K20F 8802 5th Ave Brooklyn\RI Work Plan\Figures\TRC Working Drawings\Fig 6 - Prop. Samp. Loc. Plan (K20F).dwg -- PLOT DATE: February 10, 2022 - 10:08AM -- LAYOUT: 11x17L



# LEGEND (SYMBOLS NOT TO SCALE):

- SITE BOUNDARY
- - - LOT BOUNDARY
- /// BUILDING FOOTPRINT
- X0 VENT LINE / FILL PORT
- ⊕ FLOOR DRAIN
- ⊙ SOIL, SOIL VAPOR, AND GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (NOVEMBER 2019)
- ⊗ SOIL AND SOIL VAPOR SAMPLE LOCATION AND IDENTIFICATION NUMBER (NOVEMBER 2019)
- ⊙ SOIL AND SUB-SLAB SOIL VAPOR SAMPLE LOCATION AND IDENTIFICATION NUMBER (NOVEMBER 2019)
- ⊙ TRC-SB-## / SV-##
- ⊙ TRC-SB-## / SSV-##
- ⊙ AMBIENT AIR SAMPLE LOCATION AND IDENTIFICATION NUMBER (NOVEMBER 2019)
- ⊙ TRC-AA-##
- ⊙ FLOOR DRAIN SAMPLE LOCATION AND IDENTIFICATION NUMBER (NOVEMBER 2019 & JANUARY 2020)
- ⊙ TRC-DRAIN-##
- ⊙ GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (JANUARY 2020)
- ⊙ TRC-GW-02
- ⊙ SOIL SAMPLE LOCATION AND IDENTIFICATION NUMBER (JANUARY 2020)
- ⊙ TRC-SB-1##
- ⊙ PROPOSED SOIL BORING / PERMANENT MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
- ⊙ TRC-SB-## / GW-##
- ⊙ PROPOSED DELINEATION SOIL BORING LOCATION AND IDENTIFICATION NUMBER
- ⊙ TRC-SB-06-#
- ⊙ PROPOSED SHALLOW SOIL BORING AND SUB-SLAB SOIL VAPOR SAMPLE LOCATION AND IDENTIFICATION NUMBER
- ⊙ TRC-SB-## / SSV-##
- ⊙ PROPOSED SOIL BORING SAMPLE AND IDENTIFICATION NUMBER
- ⊙ TRC-SB-##

## NOTES:

- LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND BOUNDARIES ARE APPROXIMATE.
- SOURCE: BLOCK AND LOT BOUNDARIES DEPICTED FROM WWW.PROPERTYSHARK.COM
- UST - UNDERGROUND STORAGE TANK.
- PERMANENT 2-INCH DIAMETER MONITORING WELL INSTALLED AT TRC-GW-04.

ASSUMED  
GROUNDWATER  
FLOW DIRECTION

0 40' 80'  
SCALE: 1" = 40'  
SHEET SIZE: 11" BY 17"

PROJECT: NEW YORK CITY SCHOOL CONSTRUCTION AUTHORITY 8802 5TH AVENUE AND 429 89TH STREET BLOCK: 6065, LOTS: 28 & 39 BROOKLYN, NEW YORK 11209	
TITLE: <b>PROPOSED SAMPLE LOCATION PLAN</b>	
DRAWN BY: H. DELGADO	PROJ NO.: 435632
CHECKED BY: L. O'HARA	<b>FIGURE 6</b>
APPROVED BY: J. MIRANDA	
DATE: FEBRUARY 2022	
1430 Broadway, 10th Floor New York, NY 10018 Phone: 212.221.7822 www.TRCCompanies.com	
FILE NO.:	Fig 6 - Prop. Samp. Loc. Plan (K20F).dwg



**Attachment A**  
**Health and Safety Plan Acceptance**



**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.

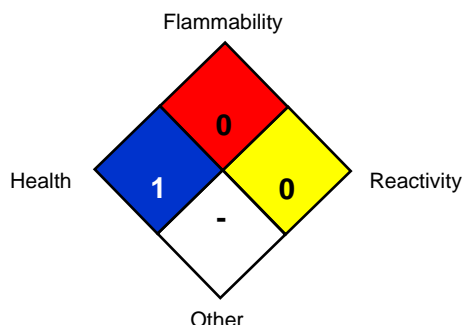
Explosion Sensitivity to Static Discharge:

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.

# MATERIAL SAFETY DATA SHEET

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 <sup>3</sup> Total Dust	15 mg/m <sup>3</sup> Total Dust	10 mg/m <sup>3</sup> Total Dust
Sodium (C10 – C16) Alkylbenzene Sulfonate	68081-81-2	10 mg/m <sup>3</sup> Total Dust	15 mg/m <sup>3</sup> Total Dust	10 mg/m <sup>3</sup> Total Dust
Sodium Tripolyphosphate	7758-29-4	10 mg/m <sup>3</sup> Total Dust	15 mg/m <sup>3</sup> Total Dust	10 mg/m <sup>3</sup> Total Dust
Tetrasodium Pyrophosphate	7722-88-5	5 mg/m <sup>3</sup>	5 mg/m <sup>3</sup>	5 mg/m <sup>3</sup>
Sodium Carbonate	497-19-8	10 mg/m <sup>3</sup> Total Dust	15 mg/m <sup>3</sup> Total Dust	10 mg/m <sup>3</sup> Total Dust
Sodium Alcohol Sulfate	151-21-3	10 mg/m <sup>3</sup> Total Dust	15 mg/m <sup>3</sup> Total Dust	10 mg/m <sup>3</sup> 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

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



# MATERIAL SAFETY DATA SHEET

ALCONOX®

## 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 <sup>3</sup> 2H
CAS# 497-19-8 LC50 Inhalation (Mouse)	1200 mg/m <sup>3</sup> 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):**

# MATERIAL SAFETY DATA SHEET

**ALCONOX®**

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

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

### Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: 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



##### 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.

## 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, CO<sub>2</sub>, 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><b>ACGIH TLV (United States, 3/2012).</b>  <b>Absorbed through skin.</b>            STEL: 8 mg/m<sup>3</sup> 15 minutes.            STEL: 2.5 ppm 15 minutes.            TWA: 1.6 mg/m<sup>3</sup> 8 hours.            TWA: 0.5 ppm 8 hours.</p> <p><b>NIOSH REL (United States, 1/2013).</b>            STEL: 1 ppm 15 minutes.            TWA: 0.1 ppm 10 hours.</p> <p><b>OSHA PEL (United States, 6/2010).</b>            STEL: 5 ppm 15 minutes.            TWA: 1 ppm 8 hours.</p> <p><b>OSHA PEL 1989 (United States, 3/1989).</b>            STEL: 5 ppm 15 minutes.            TWA: 1 ppm 8 hours.</p> <p><b>OSHA PEL Z2 (United States, 11/2006).</b>            AMP: 50 ppm 10 minutes.            CEIL: 25 ppm            TWA: 10 ppm 8 hours.</p>

## Section 8. Exposure controls/personal protection

<b>Appropriate engineering controls</b>	: 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.
<b>Environmental exposure controls</b>	: 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.
<b>Individual protection measures</b>	
<b>Hygiene measures</b>	: 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.
<b>Eye/face protection</b>	: 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.
<b>Skin protection</b>	
<b>Hand protection</b>	: 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.
<b>Body protection</b>	: 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.
<b>Other skin protection</b>	: 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.
<b>Respiratory protection</b>	: 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

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

## Section 9. Physical and chemical properties

<b>pH</b>	: Not available.
<b>Flash point</b>	: Closed cup: -11°C (12.2°F)
<b>Burning time</b>	: Not applicable.
<b>Burning rate</b>	: Not applicable.
<b>Evaporation rate</b>	: 3.5 (butyl acetate = 1)
<b>Flammability (solid, gas)</b>	: Not available.
<b>Lower and upper explosive (flammable) limits</b>	: Lower: 1.2% Upper: 7.8%
<b>Vapor pressure</b>	: 10 kPa (75.006094245 mm Hg) [room temperature]
<b>Vapor density</b>	: 2.7 (Air = 1)
<b>Specific Volume (ft<sup>3</sup>/lb)</b>	: 1.1403
<b>Gas Density (lb/ft<sup>3</sup>)</b>	: 0.877 (20°C / 68 to °F)
<b>Relative density</b>	: 0.88
<b>Solubility</b>	: Not available.
<b>Solubility in water</b>	: 1.88 g/l
<b>Partition coefficient: n-octanol/water</b>	: 2.13
<b>Auto-ignition temperature</b>	: 498°C (928.4°F)
<b>Decomposition temperature</b>	: Not available.
<b>SADT</b>	: Not available.
<b>Viscosity</b>	: Dynamic (room temperature): 0.604 mPa·s (0.604 cP)

## Section 10. Stability and reactivity

<b>Reactivity</b>	: No specific test data related to reactivity available for this product or its ingredients.
<b>Chemical stability</b>	: The product is stable.
<b>Possibility of hazardous reactions</b>	: Under normal conditions of storage and use, hazardous reactions will not occur.
<b>Conditions to avoid</b>	: 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.
<b>Incompatibility with various substances</b>	: Highly reactive or incompatible with the following materials: oxidizing materials.
<b>Hazardous decomposition products</b>	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
<b>Hazardous polymerization</b>	: 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 <sub>ow</sub>	BCF	Potential
benzene	2.13	11	low

### Mobility in soil

Soil/water partition coefficient (K<sub>oc</sub>) : 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
<b>UN number</b>	UN1114	UN1114	UN114	UN1114	UN1114
<b>UN proper shipping name</b>	BENZENE	BENZENE	BENZENE	BENZENE	BENZENE
<b>Transport hazard class(es)</b>	3 	3 	3 	3 	3 
<b>Packing group</b>	II	II	II	II	II
<b>Environment</b>	No.	No.	No.	No.	No.
<b>Additional information</b>	<b>Reportable quantity</b> 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.	<b>Explosive Limit and Limited Quantity Index</b> 1  <b>Passenger Carrying Road or Rail Index</b> 5	-	-	<b>Passenger and Cargo Aircraft</b> Quantity limitation: 5 L <b>Cargo Aircraft Only</b> Quantity limitation: 60 L <b>Limited Quantities - Passenger Aircraft</b> Quantity limitation: 1 L

## Section 14. Transport information

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

**Date of printing** : 4/26/2015.  
**Date of issue/Date of revision** : 4/26/2015.  
**Date of previous issue** : 10/16/2014.  
**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, CO<sub>2</sub>).  
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 <sup>3</sup> , 2 ppm
Sk	

### • DNELs

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

### • 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:  $\geq 0.7$  mm  
Fluorocarbon rubber (Viton)  
Value for the permeation: Level  $\geq 480$  min
- **As protection from splashes gloves made of the following materials are suitable:**  
Recommended thickness of the material:  $\geq 0.7$  mm  
Butyl rubber, BR  
Value for the permeation: Level  $\geq 10$  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/cm<sup>3</sup>
- **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

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

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Trade name: trichloromethane

(Contd. of page 7)

<ul style="list-style-type: none"> <li>14.4 Packing group</li> <li>ADR, IMDG, IATA</li> </ul>	III
<ul style="list-style-type: none"> <li>14.5 Environmental hazards:</li> <li>Marine pollutant:</li> </ul>	No
<ul style="list-style-type: none"> <li>14.6 Special precautions for user</li> <li>Danger code (Kemler):</li> <li>EMS Number:</li> <li>Segregation groups</li> <li>Stowage Category</li> <li>Stowage Code</li> </ul>	Warning: Toxic substances. 60 F-A,S-A Liquid halogenated hydrocarbons A SW2 Clear of living quarters.
<ul style="list-style-type: none"> <li>14.7 Transport in bulk according to Annex II of Marpol and the IBC Code</li> </ul>	Not applicable.
<ul style="list-style-type: none"> <li>Transport/Additional information:</li> </ul>	
<ul style="list-style-type: none"> <li>ADR</li> <li>Limited quantities (LQ)</li> <li>Excepted quantities (EQ)</li> </ul>	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"> <li>Transport category</li> <li>Tunnel restriction code</li> </ul>	2 E
<ul style="list-style-type: none"> <li>IMDG</li> <li>Limited quantities (LQ)</li> <li>Excepted quantities (EQ)</li> </ul>	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"> <li>UN "Model Regulation":</li> </ul>	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 <sub>2</sub> H <sub>2</sub> Cl <sub>2</sub>
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
<b>cis-Dichloroethylene</b>		
	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 <sup>3</sup> at 25 °C (77 °F) |
| n) Water solubility                          | No data available                        |
| o) Partition coefficient:<br>n-octanol/water | No data available                        |
| p) Auto-ignition<br>temperature              | No data available                        |
| q) Decomposition<br>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

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## 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.

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### **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](http://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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# SAFETY DATA SHEET

According to OSHA Hazard Communication Standard, 29 CFR 1910.1200

## Ethyl benzene

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### 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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- 
- 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:<br>A complex mixture of airborne solid and liquid particulates and gases (smoke).<br>Carbon monoxide.<br>Unidentified organic and inorganic compounds.<br>Flammable vapours may be present even at temperatures below the flash point.<br>The vapour is heavier than air, spreads along the ground and distant ignition is possible.<br>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.<br>Notify authorities if any exposure to the general public or the environment occurs or is likely to occur.<br>Local authorities should be advised if significant spillages cannot be contained.<br>Avoid contact with skin, eyes and clothing.<br>Isolate hazard area and deny entry to unnecessary or unprotected personnel.<br>Do not breathe fumes, vapour.<br>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.<br>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.<br>For large liquid spills (> 1 drum), transfer by mechanical   |

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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 ( $\leq 1$  m/s until fill pipe submerged to twice its diameter, then  $\leq 7$  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/m <sup>3</sup>	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 <sup>3</sup> (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 mm<sup>2</sup>/s (60 °C / 140 °F)

0.9 mm<sup>2</sup>/s (10 °C / 50 °F)

0.32 mm<sup>2</sup>/s (110 °C / 230 °F)

0.773 mm<sup>2</sup>/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.<br><br>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.<br>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<br>Remarks: May be harmful if swallowed. |
| Acute inhalation toxicity | : | LC50 : > 10 - 20 mg/l<br>Remarks: Harmful if inhaled.                    |
| Acute dermal toxicity     | : | LD50 (Rabbit): > 5000 mg/kg<br>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)
<b>Ethylbenzene</b>	<b>100-41-4</b>	<b>1000</b>	<b>1000</b>
<b>Ethylbenzene</b>	<b>100-41-4</b>	<b>100</b>	<b>100 (F003)</b>

\*: 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
--------------	----------

#### 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](http://www.P65Warnings.ca.gov).

#### California List of Hazardous Substances

Ethylbenzene	100-41-4
--------------	----------

#### 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](http://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.

# Helium, compressed

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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.

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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

## 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

### 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/m³
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

## Safety Data Sheet P-4602

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Supersedes: 06/23/2015

### 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

## Safety Data Sheet P-4602

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Date of issue: 01/01/1979 Revision date: 10/17/2016 Supersedes: 06/23/2015

### 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 outlet 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

## Safety Data Sheet P-4602

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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
-------------------------------------	-----------------------------------

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

## Safety Data Sheet P-4602

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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](http://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

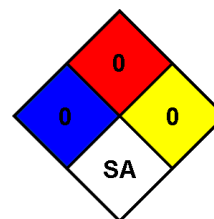
: 0 - Materials that will not burn.

#### 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.



<b>SECTION 5</b>	<b>FIRE FIGHTING MEASURES</b>
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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.

<b>SECTION 6</b>	<b>ACCIDENTAL RELEASE MEASURES</b>
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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.

<b>SECTION 7:</b>	<b>HANDLING AND STORAGE</b>
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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 <sup>3</sup>

ACGIH TLV = 5 ppm (7.59 mg/m<sup>3</sup>) 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

<b>SECTION 10:</b>	<b>STABILITY AND REACTIVITY</b>
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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.

<b>SECTION 11:</b>	<b>TOXICOLOGICAL INFORMATION</b>
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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 <sub>50</sub> :	3124 ppm, (1 hour)
Rabbit - Dermal LD <sub>50</sub> :	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 <sub>50</sub> Mosquito fish: 282 mg/l, 96 hours Fish LC <sub>50</sub> 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.



<b>SECTION 14:</b>	<b>TRANSPORT INFORMATION</b>
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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.
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**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

<b>SECTION 15</b>	<b>REGULATORY INFORMATION</b>
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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
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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.

**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

<b>GHS product identifier</b>	: Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen
<b>Other means of identification</b>	: Not available.
<b>Product use</b>	: Synthetic/Analytical chemistry.
<b>SDS #</b>	: 002103
<b>Supplier's details</b>	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
<b>Emergency telephone number (with hours of operation)</b>	: 1-866-734-3438

## Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: GASES UNDER PRESSURE - Compressed gas

### GHS label elements

<b>Hazard pictograms</b>	: 
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<b>Signal word</b>	: Warning
<b>Hazard statements</b>	: Contains gas under pressure; may explode if heated.

### Precautionary statements

<b>General</b>	: 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.
----------------	--

<b>Prevention</b>	: Use and store only outdoors or in a well ventilated place.
-------------------	--

<b>Response</b>	: Not applicable.
-----------------	-------------------

<b>Storage</b>	: Protect from sunlight. Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.
----------------	---

<b>Disposal</b>	: Not applicable.
-----------------	-------------------

<b>Hazards not otherwise classified</b>	: None known.
---	---------------

## 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/ft<sup>3</sup>)** : 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

<b>Reactivity</b>	: No specific test data related to reactivity available for this product or its ingredients.
<b>Chemical stability</b>	: The product is stable.
<b>Possibility of hazardous reactions</b>	: Under normal conditions of storage and use, hazardous reactions will not occur.
<b>Conditions to avoid</b>	: No specific data.
<b>Incompatibility with various substances</b>	: Extremely reactive or incompatible with the following materials: reducing materials and combustible materials.
<b>Hazardous decomposition products</b>	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
<b>Hazardous polymerization</b>	: 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<sub>oc</sub>)** : 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
<b>UN number</b>	UN1956	UN1956	UN1956	UN1956	UN1956
<b>UN proper shipping name</b>	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)
<b>Transport hazard class(es)</b>	2.2 	2.2 	2.2 	2.2 	2.2 
<b>Packing group</b>	-	-	-	-	-
<b>Environment</b>	No.	No.	No.	No.	No.
<b>Additional information</b>	-	<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
<b>Lead</b>		
	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

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## 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

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## 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

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## 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 <sup>3</sup>	USA. ACGIH Threshold Limit Values (TLV)
		Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m <sup>3</sup>	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 <sup>3</sup>	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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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](http://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: 6.3

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
<b>Manganese</b>		
	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 <sup>3</sup>	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 (CO<sub>2</sub>), 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](http://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

<b>Other:</b>	Wear suitable protective clothing.
<b>Respiratory Protection:</b>	In case of inadequate ventilation use suitable respirator.
<b>Hygiene measures:</b>	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

<b>Physical state:</b>	Liquid
<b>Form:</b>	Liquid
<b>Color:</b>	Colorless
<b>Odor:</b>	Ether-like odor
<b>Odor threshold:</b>	No data available.
<b>pH:</b>	Not applicable
<b>Melting point/freezing point:</b>	-22 - -19 °C
<b>Initial boiling point and boiling range:</b>	121 - 121.4 °C
<b>Flash Point:</b>	Not applicable
<b>Evaporation rate:</b>	No data available.
<b>Flammability (solid, gas):</b>	No data available.
<b>Upper/lower limit on flammability or explosive limits</b>	
<b>Flammability limit - upper (%):</b>	No data available.
<b>Flammability limit - lower (%):</b>	No data available.
<b>Explosive limit - upper (%):</b>	No data available.
<b>Explosive limit - lower (%):</b>	No data available.
<b>Vapor pressure:</b>	1.9 kPa (20 °C) 2.47 - 2.5 kPa (25 °C) 58.5 kPa (100 °C)
<b>Vapor density:</b>	5.7 (Air=1)
<b>Density:</b>	1.62 g/ml (20 °C)
<b>Relative density:</b>	1.62 (20 °C)
<b>Solubility(ies)</b>	
<b>Solubility in water:</b>	0.15 g/l (25 °C)
<b>Solubility (other):</b>	chloroform: Miscible ether: Miscible hexane: Miscible alcohol: Miscible
<b>Partition coefficient (n-octanol/water):</b>	3.40
<b>Auto-ignition temperature:</b>	No data available.
<b>Decomposition temperature:</b>	No data available.
<b>Viscosity:</b>	No data available.
<b>Other information</b>	
<b>Molecular weight:</b>	165.83 g/mol (C <sub>2</sub> Cl <sub>4</sub> )

## 10. Stability and reactivity

<b>Reactivity:</b>	No dangerous reaction known under conditions of normal use.
<b>Chemical Stability:</b>	Material is stable under normal conditions.

<b>Possibility of hazardous reactions:</b>	Hazardous polymerization does not occur.
<b>Conditions to avoid:</b>	Heat. Light. Moisture. Contact with incompatible materials.
<b>Incompatible Materials:</b>	Strong oxidizing agents. Strong acids. Strong alkalis.
<b>Hazardous Decomposition Products:</b>	Thermal decomposition may release oxides of carbon. Hydrogen Chloride. Phosgene.

## 11. Toxicological information

### Information on likely routes of exposure

<b>Inhalation:</b>	None known or expected under normal use.
<b>Skin Contact:</b>	Prolonged skin contact may cause temporary irritation.
<b>Eye contact:</b>	May cause temporary eye irritation.
<b>Ingestion:</b>	None known or expected under normal use.

### Information on toxicological effects

#### Acute toxicity (list all possible routes of exposure)

<b>Oral</b>	
<b>Product:</b>	LD 50 (Rat): 3,005 - 3,835 mg/kg
<b>Dermal</b>	
<b>Product:</b>	No data available.
<b>Inhalation</b>	
<b>Product:</b>	LC 50 (Rat, 8 h) 5000 ppm

<b>Repeated dose toxicity</b>	
<b>Product:</b>	No data available.

<b>Skin Corrosion/Irritation</b>	
<b>Product:</b>	Prolonged skin contact may cause temporary irritation.

<b>Serious Eye Damage/Eye Irritation</b>	
<b>Product:</b>	May cause temporary eye irritation.

<b>Respiratory or Skin Sensitization</b>	
<b>Product:</b>	Not a skin nor a respiratory sensitizer.

<b>Carcinogenicity</b>	
<b>Product:</b>	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

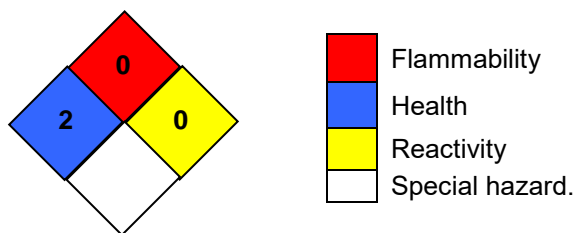
**Inventory Status:**

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 CO<sub>2</sub>, 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.
<b>Inhalation</b>	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.
<b>Ingestion</b>	Do not induce vomiting. Call a physician or Poison Control Center immediately.
<b>Most important symptoms and effects</b>	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
<b>Notes to Physician</b>	Treat symptomatically

## 5. Fire-fighting measures

<b>Suitable Extinguishing Media</b>	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
<b>Unsuitable Extinguishing Media</b>	No information available
<b>Flash Point</b>	79 °C / 174.2 °F
<b>Method -</b>	No information available
<b>Autoignition Temperature</b>	605 °C / 1121 °F
<b>Explosion Limits</b>	
<b>Upper</b>	8.6 vol %
<b>Lower</b>	1.7 vol %
<b>Sensitivity to Mechanical Impact</b>	No information available
<b>Sensitivity to Static Discharge</b>	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 (CO<sub>2</sub>)

### 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

<b>Health</b>	<b>Flammability</b>	<b>Instability</b>	<b>Physical hazards</b>
4	2	1	N/A

## 6. Accidental release measures

<b>Personal Precautions</b>	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.
<b>Environmental Precautions</b>	Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
<b>Methods for Containment and Clean Up</b>	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 <sup>3</sup> Skin TWA: 5 ppm TWA: 19 mg/m <sup>3</sup>	IDLH: 250 ppm TWA: 5 ppm TWA: 19 mg/m <sup>3</sup> Ceiling: 15.6 ppm Ceiling: 60 mg/m <sup>3</sup>	TWA: 5 ppm TWA: 19 mg/m <sup>3</sup> STEL: 10 ppm STEL: 38 mg/m <sup>3</sup>

### 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.

### 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

<b>Physical State</b>	Crystalline Solid
<b>Appearance</b>	Colorless - Translucent White
<b>Odor</b>	pungent
<b>Odor Threshold</b>	No information available
<b>pH</b>	6 @ 20°C 10 g/L aq.sol
<b>Melting Point/Range</b>	39 - 42 °C / 102.2 - 107.6 °F
<b>Boiling Point/Range</b>	182 °C / 359.6 °F @ 760 mmHg
<b>Flash Point</b>	79 °C / 174.2 °F
<b>Evaporation Rate</b>	Not applicable
<b>Flammability (solid,gas)</b>	No information available
<b>Flammability or explosive limits</b>	
<b>Upper</b>	8.6 vol %
<b>Lower</b>	1.7 vol %
<b>Vapor Pressure</b>	0.4 mbar @ 20 °C
<b>Vapor Density</b>	Not applicable
<b>Specific Gravity</b>	1.070
<b>Solubility</b>	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

<b>Reactive Hazard</b>	Yes
<b>Stability</b>	Hygroscopic, Light sensitive.
<b>Conditions to Avoid</b>	Avoid dust formation. Incompatible products. Exposure to moisture. Exposure to light. Keep away from open flames, hot surfaces and sources of ignition.
<b>Incompatible Materials</b>	Acids, Bases, Strong oxidizing agents, Halogens, lead, Metals
<b>Hazardous Decomposition Products</b>	Carbon monoxide (CO), Carbon dioxide (CO <sub>2</sub> )
<b>Hazardous Polymerization</b>	Hazardous polymerization does not occur.
<b>Hazardous Reactions</b>	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 <sup>3</sup> /8h (Rat)

**Toxicologically Synergistic Products** No information available

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

<b>Irritation</b>	Causes burns by all exposure routes
<b>Sensitization</b>	No information available
<b>Carcinogenicity</b>	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/m<sup>3</sup> 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:** C<sub>2</sub>HCl<sub>3</sub>

**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/m<sup>3</sup>/20M;

Inhalation, mouse: LC50 = 262000 mg/m<sup>3</sup>/30M;

Inhalation, mouse: LC50 = 40000 mg/m<sup>3</sup>/4H;

Inhalation, rat: LC50 = 140700 mg/m<sup>3</sup>/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
<b>Shipping Name:</b>	TRICHLOROETHYLENE	TRICHLOROETHYLENE
<b>Hazard Class:</b>	6.1	6.1
<b>UN Number:</b>	UN1710	UN1710
<b>Packing Group:</b>	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

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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)

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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 <sub>7</sub> H <sub>8</sub>
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
<b>Toluene</b>		
	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.

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## 4. FIRST AID MEASURES

### 4.1 Description of first aid measures

#### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. 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<br>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)<br>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 <sup>3</sup> 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/m<sup>3</sup>

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](http://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

<b>GHS product identifier</b>	: Xylenes
<b>Chemical name</b>	: xylene
<b>Other means of identification</b>	: 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)
<b>Product type</b>	: Liquid.
<b>Product use</b>	: Synthetic/Analytical chemistry.
<b>Synonym</b>	: 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)
<b>SDS #</b>	: 001064
<b>Supplier's details</b>	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
<b>24-hour telephone</b>	: 1-866-734-3438

## Section 2. Hazards identification

<b>OSHA/HCS status</b>	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
<b>Classification of the substance or mixture</b>	: 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**

#### **Hazard statements**

- : Danger
- : 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, CO<sub>2</sub>, 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><b>ACGIH TLV (United States, 3/2017).</b>            STEL: 651 mg/m<sup>3</sup> 15 minutes.            STEL: 150 ppm 15 minutes.            TWA: 434 mg/m<sup>3</sup> 8 hours.            TWA: 100 ppm 8 hours.</p> <p><b>OSHA PEL (United States, 6/2016).</b>            TWA: 435 mg/m<sup>3</sup> 8 hours.            TWA: 100 ppm 8 hours.</p> <p><b>OSHA PEL 1989 (United States, 3/1989).</b>            STEL: 655 mg/m<sup>3</sup> 15 minutes.            STEL: 150 ppm 15 minutes.            TWA: 435 mg/m<sup>3</sup> 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 (ft<sup>3</sup>/lb)** : 1.1628
- Gas Density (lb/ft<sup>3</sup>)** : 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 <sub>ow</sub>	BCF	Potential
xylene	3.12	8.1 to 25.9	low

### Mobility in soil

Soil/water partition coefficient (K<sub>oc</sub>) : 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.

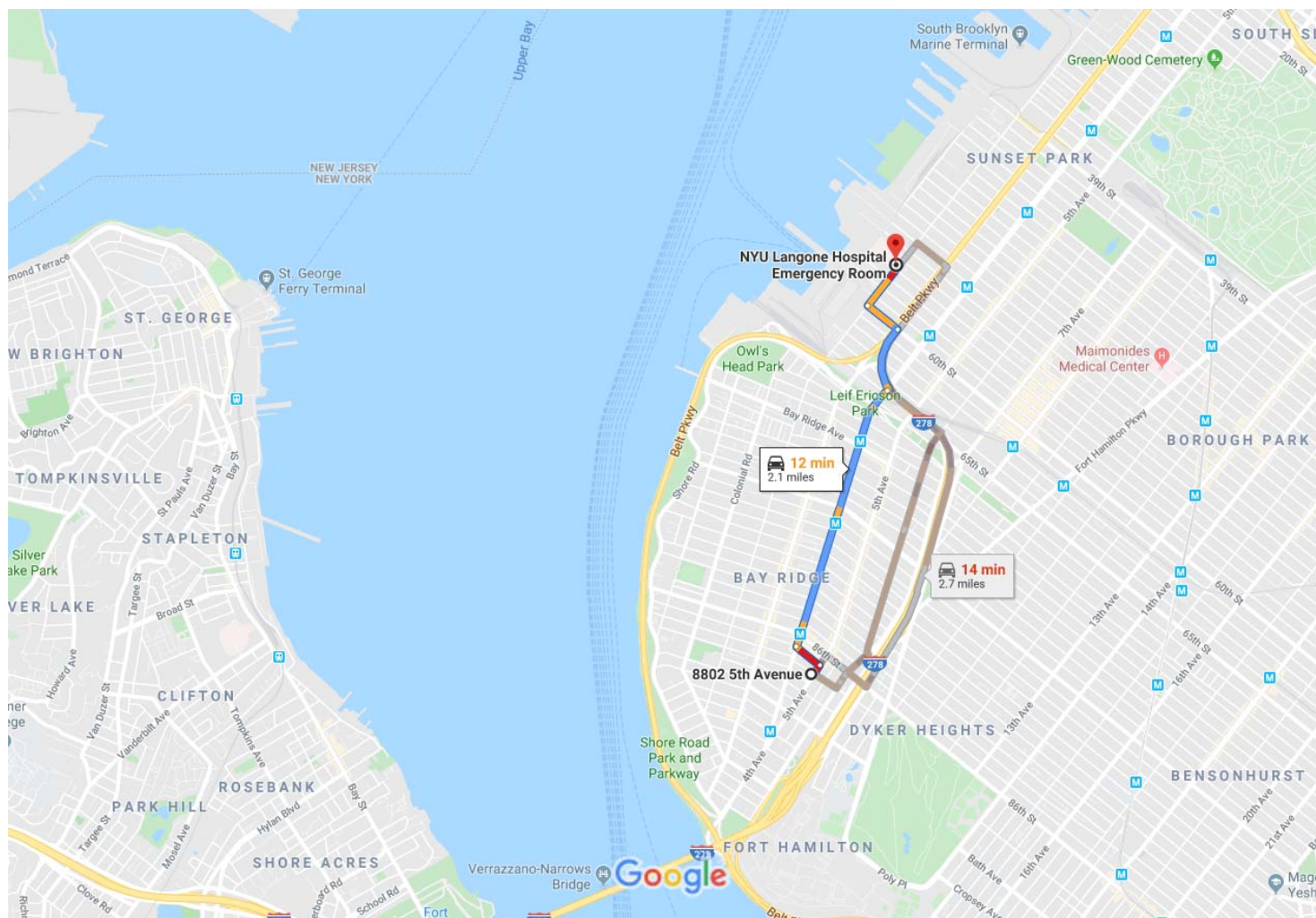
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

**Attachment C**  
**Hospital Route**



8802 5th Avenue, Brooklyn, NY to NYU Langone Hospital Emergency Room

Drive 2.1 miles, 12 min



Map data ©2019 Google 2000 ft

## 8802 5th Ave

Brooklyn, NY 11209

- ↑ 1. Head northeast on 5th Ave toward 88th St  
256 ft
  - ↩ 2. Turn left onto 87th St  
0.1 mi
  - ↪ 3. Turn right at the 1st cross street onto 4th Ave  
1.2 mi
  - ↩ 4. Turn left  
0.3 mi
  - ↩ 5. Turn left onto 60th St  
0.2 mi
  - ↪ 6. Turn right onto 2nd Ave  
0.2 mi
- i** Destination will be on the left

## NYU Langone Hospital Emergency Room

150 55th St, Brooklyn, NY 11220

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

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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

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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

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- 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

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- 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

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- 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) <b>TRC</b> 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: <b>ANSI Cut Level ___ Kevlar</b> ___ 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:					
<b>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.</b>					
<b>1 JOB TASKS</b>		<b>2 POTENTIAL HAZARDS</b>		<b>3 HAZARD CONTROLS (beyond wearing "Required" PPE)</b>	
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.		
<sup>1</sup> JOB TASKS	<sup>2</sup> POTENTIAL HAZARDS	<sup>3</sup> HAZARD CONTROLS (beyond wearing "Required" PPE)
2) Sample Storage and Well Closure	a. Damage to Samples b. Well Damage	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)		
<sup>1</sup> JOB TASKS	<sup>2</sup> POTENTIAL HAZARDS	<sup>3</sup> HAZARD CONTROLS (beyond wearing "Required" PPE)
4)		
LOCATION(S) WHERE HAZARD IS TO BE EXPECTED		<sup>3</sup> HAZARD CONTROLS (beyond wearing "Required" PPE)
1.	a.	a.
2.	a.	a.
3.	a.	a.

## Field Notes:

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**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) <b>TRC</b> 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			
<b>PERSONAL PROTECTION EQUIPMENT (PPE) QUICK SUMMARY</b> Required PPE (indicate with "R") vs. Must Have Available On-site (indicate "A")					
R REFLECTIVE VEST R HARD HAT R GLOVES: <b>ANSI Cut Level 4&amp;5 Kevlar</b> 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.					
<b>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.</b>					
<b>1 JOB TASKS</b>		<b>2 POTENTIAL HAZARDS</b>		<b>3 HAZARD CONTROLS (beyond wearing "Required" PPE)</b>	
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.		
<sup>1</sup> JOB TASKS	<sup>2</sup> POTENTIAL HAZARDS	<sup>3</sup> 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 (&gt;50 lbs).</p> <p>g1. All personnel will use hearing protection within work area while heavy machinery is operating at &gt;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.		
<sup>1</sup> JOB TASKS	<sup>2</sup> POTENTIAL HAZARDS	<sup>3</sup> HAZARD CONTROLS (beyond wearing "Required" PPE)
2 cont.)	<ul style="list-style-type: none"> <li>i. Exposure to impacted soil or groundwater.</li> <li>j. Toxic or explosive atmosphere.</li> <li>k. Opening/handling core sleeves.</li> <li>l. Inclement weather/lightning.</li> <li>m. Heat illness.</li> <li>n. Cold illness.</li> </ul>	<ul style="list-style-type: none"> <li>i1. Wear latex or nitrile gloves during handling of soil or ground water.</li> <li>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.</li> <li>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.</li> <li>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.</li> <li>m1. Refer to Activity Performed in Hot Illness Prevention SA.</li> <li>n1. Refer to Activity Performed in Cold Illness Prevention SA.</li> </ul>
3) Boring Completion	<ul style="list-style-type: none"> <li>a. Bad organization causing cross-contamination of soil, groundwater, or personnel.</li> <li>b. Moving heavy objects (&gt;50-lbs) and mixing grout/concrete.</li> <li>c. Opening/closing/moving drums.</li> <li>d. Slips, trips, falls and physical injury during auger removal.</li> <li>e. Overspray and cross-contamination during rod decontamination.</li> </ul>	<ul style="list-style-type: none"> <li>a1. Waste management—Identify and delineate soil stockpile area or storage area if soil cuttings/purge water are to be drummed.</li> <li>a2. Blot up puddles of standing water and the work area will be swept.</li> <li>b1. Get assistance for moving heavy objects and mixing grout/concrete. Use mechanical aids to move objects or mix grout/concrete.</li> <li>c1. Wear must wear ANSI cut rated 4 or 5 Kevlar gloves during the opening and closing of drums to protect fingers.</li> <li>c2. Use only drum dolly to move drums with soil, hydrated bentonite grout, or concrete or other heavy contents.</li> <li>c3. Empty metal drums could also cause strain or injury if not moved properly. Use caution and appropriate tools (e.g., dolly).</li> <li>d1. Place all removed rods to side, so as not to become a trip hazard.</li> <li>e1. See PPE Quick Summary.</li> <li>e2. Do not overspray while cleaning rods. Create a "clean zone" with plastic liner for placement of decontaminated rods.</li> </ul>

Always perform a Safety Assessment (Hazard Hunt): 1) prior to starting work; 2) when changing tasks; and 3)		
<sup>1</sup> JOB TASKS	<sup>2</sup> POTENTIAL HAZARDS	<sup>3</sup> HAZARD CONTROLS (beyond wearing "Required" PPE)
LOCATION(S) WHERE HAZARD IS TO BE EXPECTED		<sup>3</sup> HAZARD CONTROLS (beyond wearing "Required" PPE)
1.	a.	a.
2.	a.	a.
3.	a.	a.

Field Notes:

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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**



# Daily Pre-Job Safety Briefing

Project Name: Proposed Public School Facility K20F Project Number: 368706  
Work Location: 8802 5th Avenue and 429 89th Street, Brooklyn, NY Date: \_\_\_\_\_  
Tasks Performed: Phase II Environmental Site Investigation Time: \_\_\_\_\_ AM PM  
Client Name: NYCSCA Submitted By: \_\_\_\_\_

Health and Safety Plan Available Onsite: Yes ☒ No ☐ Health and Safety Plan Location: \_\_\_\_\_  
Emergency Facility(s): NYU Langone Hospital Emergency Room Number(s): (718) 630-7185  
Physical Address: 150 55th Street, Brooklyn, NY 11220  
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				
<b>Fall Protection</b>	<input type="checkbox"/>	<input type="checkbox"/>	_____	Hot Work	<input type="checkbox"/>	<input type="checkbox"/>	<b>Work Procedures:</b> <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
<b>Eye/Face</b>	<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
<b>Respirator</b>	<input type="checkbox"/>	<input type="checkbox"/>	_____	Confined Space	<input type="checkbox"/>	<input type="checkbox"/>	<b>People:</b> <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
<b>Foot Protection</b>	<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"/>	<b>Tools/Equipment:</b> <input type="checkbox"/> Adequate cover-up
<b>Hand Protection</b>	<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)				<b>Employee Certification/Training Required</b>			<input type="checkbox"/> Inspection of tools/equipment
<b>Head Protection</b>	<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
<b>Clothing</b>	<input type="checkbox"/>	<input type="checkbox"/>	_____	Mobile Equipment Operator	<input type="checkbox"/>	<input type="checkbox"/>	<b>Special Precautions:</b> <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
<b>Hearing Protection</b>	<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"/>	<b>Other:</b> _____

**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**



## 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.





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:	

Subcontractor Involvement / Description of Incident	
44	Subcontractor Involved: <input type="checkbox"/> Yes <input type="checkbox"/> No
45	Name of Company:
46	Address:
47	Contact Name and Phone Number:
48	Subcontractor Description of Incident:

Witness Involvement / Description of Incident	
49	Witnesses to Incident: <input type="checkbox"/> Yes <input type="checkbox"/> No
50	Name(s) and Address(s):
51	Phone Number(s):
52	Witness Description of Incident:

Personal Protective Equipment (PPE)	
53	List PPE required to complete the task: (glasses, gloves, shoes, hard hat, respirator, hearing protection, etc.)
54	Was the employee using the proper PPE at the time of the Incident?

Immediate Corrective Actions	
55	Describe the immediate corrective actions taken:
56	Immediate Supervisor: Signature: Date:
57	Employee: Signature: Date:

Supervisor’s Post-Incident Review and Recommendations	
Safety Violation	
	<div><input type="checkbox"/> Yes</div> <div><input type="checkbox"/> No</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: _____

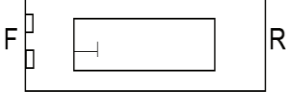


# AUTO INCIDENT REPORT

## 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

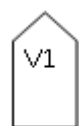
Insurance Company Name: \_\_\_\_\_ Policy Number: \_\_\_\_\_

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: \_\_\_\_\_

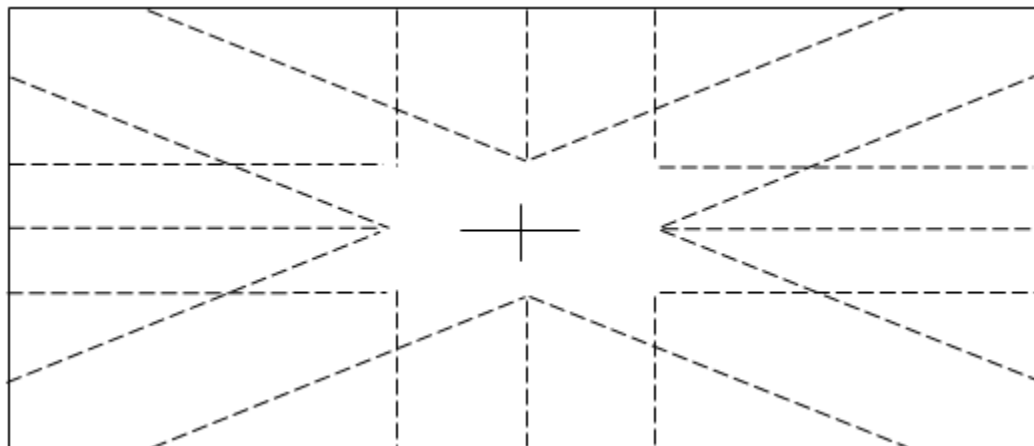
PLEASE DESCRIBE THE INCIDENT AND COMPLETE THE DIAGRAM BELOW. Be sure to indicate as many details as possible (i.e., How many lanes in each direction; Were there any turn lanes; What kind of traffic controls were there – light, stop sign, yield sign, Positions of vehicles on impact).



V-1 TRC Vehicle



V-2 Other Vehicle



Completed By: \_\_\_\_\_ Signature: \_\_\_\_\_

**Attachment H**  
**Observation Forms**

# TRC SAFETY OBSERVATION FORM

Revised January 2014

Location/Project Name: _____		Date: _____	
Observer Name: _____			
Observee Name: _____		Time: _____	
<b>Task Observed</b>			
<b>Description of Task Observed and Background Information</b>			
<b>Positive Comments</b>			
<b>Conclusions / Why the Questionable Items Occurred?</b>			
Feedback Session Conducted By: _____		Date: _____	
Name of Observee's Supervisor: _____		Time: _____	
<b>At-Risk Observations/Root Cause Analysis</b>			
<b><u>Personal Factor:</u></b> (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		<b><u>Job Factor:</u></b> (5) Lack of or inadequate operational procedures or work standards (6) Inadequate communication of expectations or work standards (7) Inadequate tools or equipment	
<b>At-Risk Observation #</b>	<b>Root Cause Analysis #</b>	<b>Solution(s) To Prevent Potential Incident from Occurring</b>	<b>Person Responsible</b>
<b>Agreed Due Date</b>	<b>Date Completed</b>		
<b>Results of Verification (were solutions done?) and Validation (were solutions effective?)</b>			
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)			
<b>Total #</b>	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:	
<b>Conditions</b>			
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
<b>Description of Incident or Potential Hazard:</b>			
<b>Task Performed at Time of Incident:</b>			
<b>Causes (Primary and Contributing):</b>			
<b>Corrective Action(s) Taken (remove the hazard, replace, repair, or retrain):</b>			
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](mailto:mglenn@trcsolutions.com).

**Attachment J**  
**COVID-19 Guidelines for Field Activities**

	TRC HEALTH AND SAFETY MANAGEMENT SYSTEM		EHS Policy
	DOCUMENT TITLE: COVID-19 Guidelines for Field Activities		Management System Procedures
	DOCUMENT NUMBER: CP052.1	Revision Number: 3	Compliance Programs
	APPROVED BY: Mike Glenn	Page 1 of 5	Forms, Checklists, Permits, etc.


## 1. ASSESSING FIELD ACTIVITIES FOR COVID-19 RISK

Following TRC's health and safety management system, work activities should be assessed to identify possible hazards and the precautions necessary to mitigate risk to an acceptable level, including risks associated with COVID-19. TRC is following the US Occupational Safety and Health Administration's (OSHA) risk assessment guidance for COVID-19. Project-specific controls that are developed through the risk assessment process must be communicated to project employees and also listed in the project Health and Safety Plan.

### 1.1. Risk Assessment

To determine appropriate precautions, OSHA has divided job tasks into four risk exposure levels: very high, high, medium, and lower risk. The majority of TRC's work is considered Low risk.

- **Very High:** Exposure risk jobs are those with high potential for exposure to known or suspected sources of COVID-19 during specific medical, postmortem, or laboratory procedures. Workers in this category include healthcare workers and healthcare or laboratory personnel collecting or handling specimens from known or suspected COVID-19 patients.
  - **Precautions:** TRC does not engage in Very High-risk work.
- **High:** Exposure risk jobs are those with high potential for exposure to known or suspected sources of COVID-19. Workers in this category include healthcare delivery and support staff (e.g., doctors, nurses, and other hospital staff who must enter patients' rooms) exposed to known or suspected COVID-19 patients.
  - **Precautions:** TRC does not engage in High-risk work.
- **Medium:** Exposure risk jobs include those that require frequent and/or close contact with (i.e., within 6 feet of) people who may be infected with COVID-19, but who are not known or suspected COVID-19 patients. In areas without ongoing community transmission, workers in this risk group may have frequent contact with travelers who may return from international locations with widespread COVID-19 transmission. In areas where there is ongoing community transmission, workers in this category may have contact be with the general public (e.g., in schools, high-population-density work environments, and some high-volume retail settings).
  - **Precautions**
    - Continue to follow the CDC's guidelines for social distancing and hand hygiene.
    - Where appropriate, limit client and third-party access to the worksite or restrict access to only certain workplace areas.
    - Consider strategies to minimize face-to-face contact (e.g., drive through windows, phone-based communication, telework).


	TRC HEALTH AND SAFETY MANAGEMENT SYSTEM		EHS Policy
	DOCUMENT TITLE: COVID-19 Guidelines for Field Activities		Management System Procedures
	DOCUMENT NUMBER: CP052.1	Revision Number: 3	Compliance Programs
	APPROVED BY: Mike Glenn	Page 2 of 5	Forms, Checklists, Permits, etc.

- Employees and Project Managers with medium exposure risk may need to wear some combination of gloves (i.e., nitrile), a face mask (or ½ mask tight-fitting respirator), and/or a face shield or goggles. PPE ensembles for workers in the medium exposure risk category will vary by work task, the results of the hazard assessment, and the types of exposures workers have on the job.
- **Lower:** Exposure risk (caution) jobs are those that do not require contact with people known to be, or suspected of being, infected with COVID-19 nor frequent close contact with (i.e., within 6 feet of) the general public. Workers in this category have minimal occupational contact with the public and other coworkers.
  - **Precautions** – While OSHA does not recommend specific controls for Low-risk work, TRC will continue to follow the CDC’s primary precautions including social distancing and hand hygiene.

## 1.2. Best Practices

TRC has identified additional best practices that can be used to further mitigate potential exposure to COVID-19. In addition, the CDC’s COVID-19 guidelines which include social distancing and hand hygiene, the following options should be considered.

- **Travel**
  - Drive in separate vehicles
  - Consider completing task alone
  - Have passenger sit in back seat
  - Sanitize your hands after using the fuel pump
  - Sanitize interior surfaces of rental vehicles
  - Driving instead of flying
- **Project Sites**
  - Use disposable chemical resistant gloves (i.e., nitrile) when disinfectant wipes are not available
  - Schedule work during “off hours” when less people are around
  - Wait until 3 days after last person left the area, if possible
  - Consider using a ½ mask tight-fitting respirator when N95 masks are not available (if deemed appropriate)
  - Contact clients via telephone or video conference instead of face-to-face meetings

	TRC HEALTH AND SAFETY MANAGEMENT SYSTEM		EHS Policy
	DOCUMENT TITLE: COVID-19 Guidelines for Field Activities		Management System Procedures
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- **Construction sites**


- Avoid “tailgate meetings” or “water cooler meetings” without following social distancing protocols
- Avoid sharing pens/pencils
- Safety Meetings should be held in groups of 10 or less and should observe 6’ personal distance
- Stagger lunch times to minimize social gatherings; consider eating in separate areas
- All lunch waste, bottles and cans should be disposed of immediately after use
- Never share PPE (hard hats, high visibility vests, personal floatation device, safety glasses, etc.
- Avoid community coffee pots in field offices
- Provide disposable paper cups at drinking stations
- Wear gloves when operating equipment and if possible, limit one operator to a piece of equipment. Sanitize controls after use
- No sharing hand tools
- Set up hand cleaning or sanitizing stations at various locations on the site, ideally near port-o-lets
- Put your clothing directly in the washing machine at the end of shift
- Limit number of workers in confined spaces as much as possible
- Use telephones or Skype meetings to avoid face-to-face meetings when possible

## 2. SYMPTOMS AND PRECAUTIONS FOR COVID-19

### 2.1. Background

The 2019 novel coronavirus, or COVID-19, is a new respiratory virus first identified in Wuhan, Hubei Province, China. It’s called a “novel” — or new — coronavirus, because it is a coronavirus that has not been previously identified.

Both the COVID-19 and influenza (flu) are respiratory illnesses, which have similar symptoms. Both are contagious and both can be mild or severe, even fatal in rare cases. The key difference between the novel coronavirus and influenza is we know what to expect from the flu.

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## 2.2. Symptoms of COVID-19


Initial symptoms of COVID-19 usually include fever greater than 100.4°F (38.0°C), cough, and shortness of breath. However, not all affected individuals will exhibit all symptoms. If you experience these symptoms or have been in recent close contact with someone with these symptoms, notify your doctor and stay home.

## 2.3. Steps to Follow If You Develop Symptoms

Symptoms and Warning Signs	Take the following steps
<p>These symptoms may appear 2-14 days after exposure.</p> <ul style="list-style-type: none"> <li>Fever, greater than 100.4°F (38.0°C)</li> <li>Cough</li> <li>Shortness of breath</li> </ul>	<ol style="list-style-type: none"> <li>1. Notify your field and direct supervisor that you feel ill.</li> <li>2. Supervisor shall notify Office Practice Leader/Practice Leader, Mike Glenn (949-697-7418), and your HR Business Partner immediately.</li> <li>3. Immediately isolate yourself and return to your place of lodging (return home if nearby).</li> <li>4. Contact your personal healthcare provider asap (consider using the Cigna app) for evaluation and follow their instructions.</li> <li>5. Update your field and direct supervisor of your health and work status (e.g., when do you expect to return to work).</li> <li>6. If you're diagnosed with COVID-19 notify Mike Glenn (949-697-7418) and your HR Business Partner immediately. This communication will be treated as confidential.</li> </ol>
<p>If you develop any of the following <b>emergency warning signs</b>:</p> <ul style="list-style-type: none"> <li>Difficulty breathing or shortness of breath,</li> <li>Persistent pain or pressure in the chest,</li> <li>New confusion or inability to arouse,</li> <li>Bluish lips or face</li> </ul> <p>This list is not all inclusive so please consult with your medical provider for further guidance.</p>	<ol style="list-style-type: none"> <li>1. Get medical attention immediately.</li> <li>2. If you're diagnosed with COVID-19, notify Mike Glenn (949-697-7418) and your HR Business Partner immediately. This communication will be treated as confidential.</li> </ol>

Source: CDC COVID-19 Symptoms <https://www.cdc.gov/coronavirus/2019-ncov/about/symptoms.html>



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## 2.4. Transmission


Both COVID-19 and the flu can be spread from person to person through droplets caused by an infected person coughing, sneezing or talking. Flu can be spread by an infected person for several days before their symptoms appear, and COVID-19 is believed to be spread in the same manner, but we don't yet know for sure.

## 2.5. Precautions

- Practice Social Distancing
  - Practice social distancing by avoiding large gatherings and maintaining distance (approximately 6 feet) from others when possible.
  - Do not share eating or drinking utensils, avoid close conversation, and other direct physical contact like hand shaking. "Close contact" does not include activities such as walking by a person or briefly sitting across an office.
- Hand Hygiene
  - According to the CDC, washing hands with soap and water is the best way to get rid of germs in most situations. If soap and water are not readily available, you can use an alcohol-based hand sanitizer that contains at least 60% alcohol. You can tell if the sanitizer contains at least 60% alcohol by looking at the product label.
- Practice good respiratory hygiene – covering mouth and nose when coughing or sneezing, using tissues and disposing of them correctly.
- Obtain immunizations recommended by healthcare providers to help avoid disease.
- Early self-isolation of those feeling unwell, feverish and having other symptoms of flu.
- Avoiding touching your eyes, nose or mouth.
- Frequently disinfect all areas that are likely to have frequent hand contact (like doorknobs, faucets, handrails).

## 2.6. Client Meetings/Interactions

Be aware of any restrictions or requirements that clients have in place regarding visiting client facilities or attending meetings. Verify with supervisor/project managers prior to visiting client facilities or meetings in person.

	<b>TRC HEALTH AND SAFETY MANAGEMENT SYSTEM</b>		<div>EHS Policy</div> <div>Management System Procedures</div> <div>Compliance Programs</div> <div>Forms, Checklists, Permits, etc.</div>
	<b>DOCUMENT TITLE:</b> Pandemic Program		
	<b>DOCUMENT NUMBER:</b> CP052	<b>Revision Number:</b> 9	
	<b>APPROVED BY:</b> Mike Glenn	Page 17 of 17	

**Attachment B**  
**CP052.2 COVID-19 Questionnaire for Onsite Workers**

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 equal to or above 100.4°F, a dry cough, tiredness, or trouble breathing within the past 72 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.**

**APPENDIX D**  
**Key Personnel Qualifications**

## **DAVID S. GLASS, PE**

### **EDUCATION**

M.E., Chemical Engineering, McGill University, 1986

B.A., Chemistry, Colby College, 1983

### **PROFESSIONAL REGISTRATIONS/CERTIFICATIONS**

Professional Engineer, New York, 1992

Professional Engineer, New Jersey, 2001

Professional Engineer, Connecticut, 2005

### **AREAS OF EXPERTISE**

Mr. Glass is based in TRC's midtown Manhattan office and manages TRC's Engineering, Construction and Remediation (ECR) Practice in New York State. Mr. Glass has dedicated his career to providing environmental engineering, investigation, design, construction, compliance, and permitting services primarily to municipal agencies in New York State. He has managed and brought to successful completion many large, complex projects in New York City and throughout New York State. Mr. Glass has extensive management and technical experience in the following areas:

- Remedial Investigation and Design
- Remedial Construction Management/Inspection
- Remedial Systems Monitoring, Operation and Maintenance
- Underground and Aboveground Storage Tank Management
- Soil Vapor Intrusion Investigation and Mitigation
- Environmental Regulatory Compliance
- Landfill Investigation and Closure

### **REPRESENTATIVE EXPERIENCE (Descriptions marked with an asterisk (\*) undertaken within past three years)**

#### **New York City School Construction Authority Environmental Consulting/Hazardous Material Services Contract\***

Mr. Glass serves as Principal-in-Charge for TRC's environmental consulting hazardous materials services contract with the New York City School Construction Authority (NYCSCA). TRC has provided a broad range of services to the NYCSCA under four consecutive on-call contracts, including environmental site assessment and remedial design and construction phase services, and remedial program implementation, operation, maintenance and monitoring services. TRC has successfully completed over 400 assignments for NYCSCA since 2006.

#### **The Port Authority of NY & NJ – Expert Professional Environmental Engineering Services\***

Mr. Glass serves as Principal-in-Charge for TRC's Expert Professional Environmental Engineering services contract with the Port Authority. Since 2011 under two consecutive term

contracts, TRC has provided remedial investigation, design, construction inspection, closure and remedial systems operations, maintenance and monitoring services to the Port Authority in connection with sites in New York and New Jersey. Mr. Glass's responsibilities include review of proposals, quality control of work products, and monitoring TRC progress and effort with respect to schedule and budget. Among the projects assigned by Port Authority to TRC that Mr. Glass has served in a quality control role are: Goethals Bridge Replacement Project (Site Assessments/Investigations), Port Ivory – Howland Hook Marine Terminal (Voluntary Cleanup Program Closure/Remediation), and JFK Airport Bulk and Satellite Fuel Farms (Petroleum Spill Remediation Systems Optimization/Design).

### **MTA Long Island Rail Road (LIRR) General Engineering Consultants (GEC) Environmental Engineering Contract\***

Mr. Glass serves as Principal-in-Charge for TRC's GEC contract for environmental engineering services with the MTA Long Island Rail Road. In this capacity Mr. Glass has supervised services provided to LIRR in connection with a remedial investigation of the Morris Park Yard, design and construction of a petroleum remediation system at the Morris Park Yard, and remedial investigations of petroleum spills at the West Side Storage Yard on the west side of Manhattan and at the Richmond Hill Yard in Queens.

### **NYSDEC Superfund Standby Contract\***

Mr. Glass serves as Principal-in-Charge for services currently provided by TRC to NYSDEC under a Superfund Standby (on-call engineering services) Contract. Additionally, between 1996 and 2005, under consecutive Superfund Standby Contracts, Mr. Glass managed environmental design, construction phase and site management services provided to the NYSDEC. Under the multi-site "on-call" contracts with NYSDEC Mr. Glass has been responsible for preparation of work plans, remedial investigations, feasibility studies, interim remedial measures (IRMs), pre-design investigation reports, engineering design reports, design drawings and specifications, and engineering cost estimates for remediation of "State Superfund" sites throughout New York State.

### **CSX Transportation, Inc.\***

Mr. Glass serves as Principal-in-Charge for services provided by TRC to CSX. In this capacity Mr. Glass has supervised engineering assessments of the potential impacts of proposed environmental dredging on CSX rail bridges which span the Buffalo River, in Buffalo, New York, and Onondaga Creek and Ninemile Creek in Syracuse, NY; provided third party review and oversight in connection with complicated remediation of chlorinated solvents in soil and groundwater using in-situ thermal remediation and groundwater extraction and reinjection at Beacon Yards in Boston; and managed the environmental due diligence, remediation and environmental permitting for a new intermodal rail terminal in Pittsburgh.

**Queens West Development - Stage 2 Site Remedial Action - Long Island City, NY** In connection with an approximately \$1.5 billion development on the East River, Mr. Glass supervised the preparation of the Remedial Investigation (RI) Work Plan, RI Report, Remedial Work Plan, Final Engineering Report, and Site Management Plan, and supervised remediation

of Operable Units (OUs) 3 and 4 of the Queens West Development – Stage 2 Site, an approximately 9-acre parcel which is the location of a former Standard Oil Company refinery. In December 2010 NYSDEC issued Certificates of Completion for both OUs 3 and 4 under the New York State Brownfield Cleanup Program (BCP). Mr. Glass also managed the design of active sub-slab depressurization systems for several high-rise residential buildings at the site.

#### **NJDEP Remedial Design Services Contract**

Between 2001 and 2004, under a remedial design services contract, Mr. Glass managed predesign investigation and design services provided to the NJDEP. Under the multi-site “on-call” contract with NJDEP Mr. Glass supervised preparation of work plans, pre-design investigation reports, engineering design reports, design drawings and specifications, and engineering cost estimates for abandoned landfills, a truck fueling facility site, a former electronics manufacturing site, a bulk chemical storage terminal, an oil storage terminal, and a former metal fabricator site.

#### **Avis Budget Group, Inc. - New York, New Jersey, Connecticut and Massachusetts\***

Mr. Glass serves as Principal-in-Charge for TRC’s national environmental engineering services contract with the Avis Budget Group, Inc. TRC has provided a broad range of services to the Avis Budget Group since 2006, including environmental arbitration-related, site assessment, petroleum spill closure, and remedial design and construction phase services at several sites in New York, New Jersey, Connecticut and Massachusetts, including properties operated by Avis Budget in Manhattan, and at JFK, LaGuardia, Newark and Logan airports.

#### **Environmental Compliance, Design and Construction Services – Danbury, CT\***

Mr. Glass serves as Principal-in-Charge for TRC’s environmental engineering contract with the City of Danbury, CT. TRC has provided a broad range of services to the City since 2005, including air quality management services in connection with the closed Danbury Landfill and Public Works Complex; optimization of the landfill gas control system and enclosed landfill gas flare; city-wide compliance surveys of underground storage tanks; preparation of storm water pollution prevention plans for the City’s Public Works Complex and Water Pollution Control Plant; preparation of Spill Prevention, Control and Countermeasure (SPCC) Plans for the City’s Public Works Complex and Police Department Headquarters and related training and compliance assistance; design and construction inspection services for the removal and replacement of gasoline and diesel fuel storage tank systems and dispensers at the Fire Department headquarters; design and construction inspection services for a new vehicle fueling facility at the Public Works Complex which includes a 10,000-gallon aboveground diesel fuel tank, an 8,000-gallon aboveground gasoline tank, and overhead canopy with recessed lighting; and, design services for removal and replacement of fuel oil storage tanks at the City Airport, City Hall, and two City Public Schools.

#### **Stewart EFI Facility - VCP Site No. V00691, Yonkers, NY**

Mr. Glass served as Principal-in-Charge and supervised the services provided by TRC which resulted in reaching closure under the New York State Voluntary Cleanup Program (VCP) for the former Stewart EFI Facility. Under Mr. Glass’s supervision TRC designed and oversaw

construction of a sub-slab depressurization system (SSDS) at the former 100,000-square foot metal stamping and electroplating facility in Yonkers, New York, performed remedial design investigations, prepared an RI and Remedial Alternatives Analysis report, and coordinated with NYSDEC and NYSDOH for closure.

#### **ExxonMobil Bayway Refinery - Linden, NJ**

Mr. Glass supervised the design of the hydraulic control system for the Sludge Lagoon Operable Unit (SLOU) at the Bayway Refinery in Linden, NJ. The hydraulic control system includes 21 dual pump extraction wells, thousands of feet of buried piping, and sophisticated instrumentation and controls. The dual pump extraction wells were designed to automatically extract separately groundwater (for hydraulic control) and oil in the SLOU.

#### **48<sup>th</sup> Avenue, LLC – Long Island City, New York**

Mr. Glass represented the seller (48<sup>th</sup> Avenue, LLC) in connection with five contiguous parcels (formerly occupied by an industrial facility) in Long Island City adjacent to the East River. A significant amount of the purchase price of the properties was being held in escrow by the buyer (Toll Brothers, Inc.) pending a determination of the cost of environmental remediation prior to construction of a low rise residential development. Toll Brothers and their environmental consultant claimed the full amount in escrow was required for remediation. Mr. Glass analyzed the claim and related documentation, determined that actual costs of development attributable to environmental conditions were insignificant, and successfully argued for release of the full amount in escrow.

**Consolidated Edison Company of New York, First Avenue Properties – New York, NY** In connection with the Final Engineering Report, Mr. Glass served as the Engineer of Record for the decommissioning, demolition, and remediation of the 7-acre Waterside Steam Generating Station site located in Midtown Manhattan. Key components of the work included the asbestos abatement of the circa-1900 steam and electric generating station, the removal of a 255,000 gallon fuel oil underground storage tank, decommissioning and removal of acid and caustic tanks, demolition of three 200-foot high steel and brick smokestacks, demolition of six eight-story high boilers, sealing of twelve-foot diameter cooling water tunnels, remedial investigations, excavation and disposal of 20,000 tons of contaminated soil, and sheeting and shoring to protect adjacent roadways and public right-of-ways.

#### **KeySpan Corporation Cable Fluid Release Site - Sands Point, NY**

Mr. Glass managed the pre-design investigation, design and construction phase services for the ground water extraction and treatment system to contain and remediate the release of dielectric cable fluid from a high voltage underground electric utility-owned cable. Mr. Glass was responsible for design of the dual phase extraction well, solids filters, carbon adsorption system, instrumentation and controls, treatment system building, utilities, on-site treated water recharge system (dry well network), site access road, site drainage structures and landscaping.



**Consolidated Edison Former MGP Plant - New York, NY**

Mr. Glass supervised preparation of the Remedial Work Plan for the Consolidated Edison West 42<sup>nd</sup> Street former Manufactured Gas Plant Site. The RWP was prepared in accordance with the terms of a Voluntary Cleanup Agreement (VCA) with the NYSDEC. The remedial plan developed for the site was designed to meet the requirements of the NYSDEC for cleanup of the former MGP site, as well as allow for the planned future use of the site: construction of a high rise residential building.

**Former Textiles Processing Facility, Soil and Groundwater Remediation Services – Moonachie, NJ**

Mr. Glass managed services provided for remediation of tetrachloroethene contaminated soil and groundwater, including dense non-aqueous phase liquid (DNAPL), at a former textiles processing facility in Moonachie, New Jersey. Remedial design included selective building demolition, deep excavation, water-tight sheeting, and in-situ chemical oxidation.

**Brookhaven National Laboratory, Sediment Remediation Services – Upton, NY**

Mr. Glass managed preparation of the conceptual design drawings for remediation of contaminated sediment in the Peconic River at Brookhaven National Laboratory in Upton, New York. Mr. Glass also served as project manager for closure of the hazardous waste and mixed waste storage facility at Brookhaven National Laboratory (BNL), a Department of Energy (DOE) operated facility. Responsibilities included oversight of decontamination of four hazardous waste storage buildings and two mixed waste storage units, post-closure sampling and preparation of the final closure certification report.

**Bergen County Overpeck Park Site, Wetland and Landfill Closure Services – Leonia, NJ**

Mr. Glass was manager for stream bank stabilization, wetland restoration and landfill cover repair and closure of the over 400-acre Bergen County Department of Parks Overpeck County Park site (Leonia, New Jersey). The project included redevelopment of the landfill property for passive and active recreation.

**Southold Landfill, Landfill Closure Services – Southold, NY**

Mr. Glass managed engineering services for the closure of a 34-acre municipal solid waste landfill in Southold, New York. His responsibilities included preparation of the final landfill closure plan, plans and specifications, and a cost estimate for construction of the landfill capping system as well as supervising construction inspection services.

**Fishers Island Landfill, Landfill Closure Services – Fishers Island, NY**

Mr. Glass managed engineering services for the closure of a 10-acre landfill located in Fishers Island, New York. His responsibilities included preparation of the final landfill closure plan, and plans and specifications for closure of the landfill.

**Captain's Cove Landfill, Landfill Remediation Services – Glen Cove, NY**

Mr. Glass managed engineering services for remediation of the Captain's Cove landfill located in Glen Cove, New York (New York State Superfund Site Registry No. 1-30-032). His



responsibilities included preparation of plans and specifications for reclamation of the landfill, backfill, grading and drainage, and supervising construction inspection services.

**City of Paterson Sewer System Overflow Study – Paterson, NJ**

Mr. Glass managed services provided to the City of Paterson, New Jersey, for a combined sewer system overflow study. His responsibilities included supervising mapping of the combined sewer system, cleaning and televising sewers, flow monitoring, and modeling to identify sources of inflow and infiltration and minimize combined system overflows to surface water.

**SPECIALIZED TRAINING**

- 40-Hour OSHA Health and Safety Training

**PROFESSIONAL AFFILIATIONS**

- American Chemical Society
- American Institute of Chemical Engineers

## **JENNIFER L. MIRANDA**

### **EDUCATION**

M.S., Environmental and Occupational Health Science, Hunter College, 2002  
National Institute of Environmental and Occupational Health Fellow, 2002  
B.S., Anthropology and Human Biology, Co-major Human and Natural Ecology,  
Emory University, 1998

### **PROFESSIONAL REGISTRATIONS/CERTIFICATIONS**

Certified Asbestos Inspector, New York State Department of Labor

### **AREAS OF EXPERTISE**

Ms. Miranda has program management and technical experience in the following areas:

- Management and Quality Control of Complex Projects
- Environmental Due Diligence Assessments
- Remedial Investigation
- Environmental Remediation and Alternatives Analysis
- Environmental Compliance Audits
- Brownfields Initiatives
- Remedial Construction Management
- Pre-Demolition Regulated Building Materials Surveys
- Environmental Health and Safety
- Underground Storage Tank Management

Ms. Jennifer Miranda has over 18 years of experience and has assumed progressively increasing responsibility in environmental consulting, due diligence and remedial construction management throughout her career. Ms. Miranda serves as Principal Environmental Scientist/Office Practice Leader in TRC's New York City office, in the Engineering, Construction and Remediation (ECR) Practice, and among her responsibilities are office-wide quality control. Ms. Miranda's experience includes extensive environmental due diligence assessment, field investigation supervision, work plan and report preparation, cost estimating, remedial construction management, project management and program management. Ms. Miranda has served in the capacity of project manager and quality control officer for many large, complex and diverse environmental projects in New York City.

Ms. Miranda is currently responsible for all aspects of quality assurance and control for the environmental due diligence practice in TRC's NYC ECR (environmental due diligence and remediation) group. Ms. Miranda performs comprehensive reviews of the NYC office's work products and certifies work product quality standards have been met. Ms. Miranda is detail oriented and technically proficient in all areas of environmental due diligence in support of property transactions in New York City. Ms. Miranda excels at implementing

project controls across large project teams and across her practice by using methodical and reproducible approaches (training, templates, forms, multi-tier reviews, etc.). Ms. Miranda has been responsible for the quality of over one hundred Phase I Environmental Site Assessments (ESAs) and due diligence assignments. She has reviewed and been the Principal-in-Charge of design and implementation of over 50 Phase II Environmental Site Investigations (ESIs)/Remedial Investigations (RIs). Ms. Miranda has prepared numerous hazardous materials chapters for City and State Environmental Assessments and Impact Statements including large scale linear projects such as the Cross Harbor Freight Tunnel and Second Avenue Subway. Ms. Miranda is thoroughly familiar with local regulations and was a founding board member of the New York City Brownfield Partnership, which supports the New York City Mayor's Office of Environmental Remediation (MOER).

## **REPRESENTATIVE EXPERIENCE**

### **New York City School Construction Authority – New York, NY**

Under consecutive on-call hazardous materials services contracts with the New York City School Construction Authority, Ms. Miranda has served as the technical project lead for due diligence and remediation assignments. Responsibilities have included quality assurance for project deliverables, supervising the preparation of Phase I ESA reports, management of the preparation of Phase II ESI reports, and focused regulatory agency database and prior report reviews for leased properties (over 50 leased New York City public school properties). Recently, Ms. Miranda has provided key technical review and guidance during preparation of Phase I ESA and Phase II ESI reports for challenging proposed Public School sites (K667, K671, K710, and R840), two of which are being considered for the Brownfield Cleanup Program (K671 and K710). Ms. Miranda's expertise in the Brownfield Cleanup Program has been integral during the preliminary application phases for each of these sites.

### **The Port Authority of NY & NJ, Port Ivory Voluntary Cleanup Program Sites - VCP Site Nos. V00615, V00674, and V00675 - Staten Island, NY**

Ms. Miranda assessed the regulatory status of three VCP Sites. The three Sites encompass approximately 123-acres in the Port Ivory area of Staten Island, New York. Ms. Miranda performed a file review, site visit and prepared summaries and "road map to closure" charts for presentation to the NYSDEC case manager. Ms. Miranda presented the strategy at a meeting with the NYSDEC to achieve site closure/release and covenant not to sue for each Site. NYSDEC has approved closure of two of the sites under the VCP and the Remedial Action Work Plan for the third site has been approved by the NYSDEC.

### **New York City Department of Parks and Recreation – New York, NY**

Under TRC's on-call Citywide Consultant Environmental Services contract with the New York City Department of Parks and Recreation, Ms. Miranda serves as program manager. Responsibilities have included coordination, management and quality assurance for projects including supplemental soil investigations in

coordination with USEPA, NYSDEC and NYCDOH, design of a 50-acre capping remedy for the Redhook Ballfields under a Consent Order with the USEPA, landfill maintenance and monitoring, and regulatory compliance for the Former Bayside Fuel Oil Depot.

Ms. Miranda has provided consulting services to maintain compliance for the Former Bayside Fuel Oil Depot. The Parks Department has long-term development plans for a large waterfront park near Bushwick Inlet. In the interim, prior to large scale remediation and reconstruction as a Park, the former fuel oil terminal fuel storage and transmission systems, stormwater management systems and underlying Manufactured Gas Plant (MGP) impacts must be addressed to maintain compliance. Ms. Miranda oversaw the records review, preparation of Major Oil Storage Facility (MOSF) license Site Assessment Proposal (i.e., MOSF closure plan), preparation of the State Pollutant Discharge Elimination System (SPDES) stormwater collection and treatment system Closure Plan, and regulatory interaction with multiple parties within the NYSDEC.

#### **New York City Economic Development Corporation – On-Call Environmental Consulting Services Contract – New York, NY**

Ms. Miranda is the Principal-in-Charge for TRC's on-call environmental services contract with the New York City Economic Development Corporation (NYCEDC). Under Ms. Miranda's management, TRC has provided the following services to the NYCEDC: supplemental investigation work plans; lead investigation and dust removal; remedial oversight and management of a PCB release; asbestos surveys; in-situ soil characterization and specifications for reuse and disposal; semi-annual groundwater monitoring; annual inspections and periodic review reporting for NYSDEC VCP Site V00228, St. George Ball Park, Staten Island; remedial oversight and preparation of the site management plan and final engineering report for NYSDEC Environmental Restoration Site B000312, Bush Terminal Landfill Piers 1-4, Brooklyn; and indoor air quality monitoring and microbial sampling.

Under previous on-call contracts, Ms. Miranda managed numerous environmental site assessments and site investigations for NYCEDC. Ms. Miranda managed the large-scale Island-wide investigation of Governors Island in Upper New York Bay. Governors Island is the site of historic military and US Coast Guard operations.

#### **Industrial and Manufacturing Due Diligence, Permitting Reviews and Compliance Audits, Variety of Facilities - New York and New Jersey**

Ms. Miranda has been responsible for numerous Phase I ESAs, material compliance audits, and permitting reviews associated with a variety of industrial and manufacturing facilities including proposed solar installations on landfills, fossil fuel power plants, oil and gas transmission facilities, former pharmaceutical facilities, skin care products manufacturing facilities, an air freight warehouse and high-rise commercial buildings. Ms. Miranda has expertise in identifying significant environmental risks during the due diligence process.

For example, Ms. Miranda served as the senior reviewer/quality control officer for a Phase I ESA and Limited Environmental Regulatory Review for Sundial (a manufacturer of natural and organic skin products). The assessment encompassed four separate facilities in Amityville, NY, with the objective of identifying environmental liabilities in excess of \$50K. The purpose of the assessment was to quantify environmental liabilities in support of obtaining approval from a financial lending institution for proposed expansion of the facilities.

Recently, Ms. Miranda served as the senior reviewer for a large and complex Phase I ESA and hazardous materials chapter for an Environmental Assessment Statement (EAS) for the Rockville Centre Power Plant, which has operated since 1898. The assessment was performed to identify environmental issues which may impact a proposed Microgrid project and to identify potential mitigation measures for any issues identified. The Microgrid project consists of retiring several units, adding a new unit, ancillary upgrades to plant systems and installation of solar panels in multiple locations.

**Stewart EFI Facility - VCP Site No. V00691 - Yonkers, NY**

Ms. Miranda served as Project Manager for the regulatory closure of a former 100,000-square foot metal stamping and electroplating facility site in Yonkers, New York (NYSDEC VCP Site No. V00691). Ms. Miranda served as the primary contact with the NYSDEC Project Manager, managed the work plan preparation and implementation of the Supplemental Investigation, and preparation of the Remedial Investigation Report, Remedial Alternatives Report and the Site Management Plan. A release and covenant not to sue letter was issued by the NYSDEC for the site as a result of Ms. Miranda's efforts.

**Sequa – Former Chromalloy Facility – New York State Superfund Site No. 344039 - West Nyack, NY**

Ms. Miranda served as Project Manager for the regulatory closure of the former metal coating facility in West Nyack, New York. The Site is undergoing remediation under the New York State Inactive Hazardous Waste Disposal Site Remedial Program, administered by NYSDEC. Ms. Miranda served as the primary contact with the NYSDEC Project Manager and managed the preparation of the Interim Site Management Plan. Maintenance and monitoring of an existing remediation system, under Ms. Miranda's supervision, is ongoing.

**Spectra Energy – Natural Gas Pipeline Project - Linden, NJ to New York, NY**

Ms. Miranda served as Project Manager for the construction dewatering permitting in support of the installation of the new 20.3 mile natural gas pipeline in Staten Island and Manhattan. Ms. Miranda prepared permit applications which included treatment of dewatering fluids and discharge at ten temporary outfalls to wetlands and surface water bodies, obtained necessary permits and approvals, and administered the preparation of reports and termination of construction dewatering permits.

**Queens West Development – Stage 2 Site – Long Island City, NY**

Ms. Miranda served as the Project Manager for the over \$60 million remediation of the Queens West Development – Stage 2 Site, the site of a former oil refinery in Long Island City. In addition to the presence of several historic abandoned underground storage tank systems, buried on the site was an extensive network of historic refinery piping. The Site was contaminated with petroleum-related VOCs and SVOCs, and metals, in several instances present in soil at concentrations above TCLP regulatory limits, and a large LNAPL plume. In connection with Operable Units 3 and 4 (OUs 3 and 4) (NYSDEC BCP Site Nos. C241095 and C241096), which consist of over 9 acres adjacent to the East River developed with a public school, park, and residential/commercial towers, Ms. Miranda was responsible for the preparation of the Remedial Investigation (RI) Work Plan, RI Report, Remedial Action Work Plan, Final Engineering Reports and Site Management Plans as well as Odor and Vapor Control and Enhanced Community Air Monitoring Plans. Ms. Miranda was also responsible for supervising implementation of the work plans. The RI included advancement and sampling of over 100 soil borings, installation and sampling of a monitoring well network, soil gas sampling within the footprints of the planned buildings, sediment and surface water sampling in the East River to determine potential site impacts, locating and characterizing buried historic refinery remnants, a tidal influence study, a human health risk assessment and fish and wildlife impact analysis. Implementation of the remedial action work plan, supervised by Ms. Miranda, included high vacuum extraction of thousands of gallons of LNAPL, pre-excavation waste characterization and re-use sampling (over 250 borings and thousands of samples were collected for analysis), excavation of over 100,000 tons of contaminated soil under negative pressure enclosures (i.e., tents) and off-site disposal of excavated material, and post-remediation soil, groundwater and soil gas sampling. Ms. Miranda was responsible for financial management, investigation and construction phase field coordination and management, health and safety program management, daily and monthly reporting to the NYSDEC, community outreach program implementation and subcontractor procurement and management. Ms. Miranda served as a primary point of contact for nearby residents during the site remediation, presented at public meetings, prepared fact sheets for distribution to the public, and served as a primary point of contact with the NYSDEC and NYSDOH in connection with responding to local citizens' concerns. In addition, Ms. Miranda managed implementation of a chemical oxidation pilot test on the site, including preparation of a NYSDEC-approved pilot test work plan. In December 2010 NYSDEC issued the final Certificates of Completion for Operable Units 3 and 4 under the BCP.

**National Grid - Engineering and Consulting Services for Abatement, Decommissioning, and Demolition: Glenwood Power Station - Glenwood Landing, NY and Far Rockaway Power Station, Far Rockaway, Queens, NY**

Ms. Miranda served as Project Manager for engineering and consulting services for abatement, decommissioning and demolition of two of National Grid's oldest power plants in New York City and Long Island. The Far Rockaway and Glenwood power stations ceased operation in July 2012. TRC has provided



National Grid the following services under Ms. Miranda's management: asbestos/regulated materials surveys; structural evaluations; Phase I ESAs; preparation of subsurface investigation work plans; permitting; preparation of specifications and drawings for abatement, decommissioning and demolition; preparation of engineer's cost estimates and schedules; and preparation of bid documents. Ms. Miranda also served as project manager for bid phase services and the construction phase services for the decommissioning and demolition projects.

**New York Power Authority (NYPA) - Engineering Services during Decommissioning: Charles Poletti Power Plant – Astoria, NY**

Ms. Miranda served as the Project Manager for engineering services for the decommissioning of the Charles Poletti Power Plant. The Charles Poletti Power Plant was a steam-electric 885 megawatt facility capable of firing natural gas and fuel oil. NYPA ceased operations at Poletti in January 2010. In June 2010, TRC was contracted to provide engineering services for the decommissioning of the Charles Poletti Power Plant. Decommissioning services provided to NYPA by TRC under Ms. Miranda's management included an asbestos/regulated materials survey; coordination and oversight of asset recovery; pre-demolition structural assessment of adjoining buildings and cooling water intake and discharge structures; preparation of specifications and drawings for abatement, decommissioning, and demolition; and, preparation of an engineer's cost estimate and bid documents. In addition, Ms. Miranda managed bid phase services for the decommissioning and demolition project. Ms. Miranda also managed design services for temporary winterization of the Poletti Plant and for the relocation of electrical connections and procurement of a New Electric Fire Water Pump System. Ms. Miranda also served as the project manager during the construction phase which has included the following services: submittal review, construction engineering services, asbestos-abatement project monitoring and environmental and health and safety inspection services.

Ms. Miranda also served as the project manager for characterization of sediment in support of upland disposal of material dredged from the former cooling water discharge canal as part of the decommissioning. The decommissioning activities included the removal of the sheet pile wall which forms the Cooling Water Discharge Canal in the East River. Excess sediment deposits within the Cooling Water Discharge Canal were dredged in accordance with the Joint Application for Permit to the NYSDEC and the US Army Corps of Engineers (USACE). Ms. Miranda managed the preparation and implementation of a Field Sampling Plan (FSP) to characterize the material to be dredged for upland disposal. The FSP was prepared to meet the requirements of the NYSDEC Dredge Team and the New Jersey Department of Environmental Protection (NJDEP) Office of Dredging & Sediment Technology. Because of the limited boat access, a vibracore operator and crane were subcontracted to obtain the sediment samples from land. Global positioning system (GPS) readings were taken at the sample locations. A Sediment Sampling and Analysis Report was prepared and approved by the NYSDEC and NJDEP. Ms. Miranda worked with sediment disposal outlets in the

region to gain acceptance of the material which was transported via barge, stabilized and ultimately disposed of at an upland facility.

### **Consolidated Edison Hudson Avenue Generating Station – Brooklyn, NY**

The 12-acre Consolidated Edison Hudson Avenue Generating Station is the site of an active electric and steam generating plant that has been used as a generating station for over 80 years. Consolidated Edison was considering installing new steam boilers to replace the existing steam boilers at the Hudson Avenue Generating Station. As part of re-development of the Hudson Avenue Generating Station, Ms. Miranda supervised the Phase I ESAs, Hazardous Materials Pre-Demolition Assessments (for all existing on-site structures), preparation and implementation of the Phase II ESI Work Plan and preparation of the Phase II ESI Report.

### **Second Avenue Subway - New York, NY**

In connection with the environmental assessment of the Second Avenue Subway Route in Manhattan, Ms. Miranda prepared the Hazardous Materials chapter of the Environmental Impact Statement for the proposed transportation project. Ms. Miranda also performed the Phase I ESA using a Global Information System data sorting process to create a comprehensive database. The database was then mapped using State Plane Coordinates and summarized in the Environmental Impact Statement.

### **Long Island City – Environmental Assessment – Queens, NY**

Ms. Miranda performed a Phase I ESA of a portion of Long Island City being considered for rezoning. Based on the results of the Phase I ESA restrictive declarations or E-designations were assigned to a number of lots by the New York City Department of Environmental Protection arising from environmental concerns. This site consisted of an entire block of buildings with a history of manufacturing and commercial uses.

### **Cross Harbor Freight Movement Project – NY and NJ**

Ms. Miranda prepared the Hazardous Materials chapter of the Environmental Impact Statement (EIS) for the proposed transportation project. Ms. Miranda prepared the Phase I ESA using a Global Information System (GIS) data sorting process to create a comprehensive database. The proposed study area included 10 rail yards and approximately 25 miles of track running through New Jersey, Staten Island, Brooklyn, and Queens. The data was categorized by potential to require additional investigation and entered into a GIS database. The GIS database was then mapped using State Plane Coordinates. The resulting maps and tables were summarized in an EIS chapter and the impacts of these sites were analyzed.

### **Columbia University Master Plan – New York, NY**

Ms. Miranda provided support for the Columbia University Master Planning process for the Manhattanville campus, a 17-acre area in Harlem. The expansion included an arts complex, research space and residence halls to supplement the



university's main campus in Morningside Heights. The study area had been historically used for commercial, manufacturing and industrial uses over the past 90 years. Ms. Miranda performed a nine-block survey of hazardous materials and prepared a large-scale demolition and remediation cost estimate for the purpose of long term planning.

### **Corporate Health and Safety Program Manager**

Ms. Miranda assisted with implementation of the corporate Health and Safety Program. Ms. Miranda prepared updates to the corporate health and safety plan that included such topics as personnel protective clothing, air monitoring, site control procedures, medical surveillance program, respiratory protection program, hearing conservation, assessment of biological hazards, hazard communications, and emergency response. Ms. Miranda updated medical surveillance and incident record-keeping practices and implemented a right-to-know program. In addition, in her role as an assistant to the corporate health and safety director, Ms. Miranda conducted annual 8-hour health and safety-training classes, prepared site-specific environmental and construction phase health and safety plans, and supervised implementation of health and safety activities during hazardous waste operations.

### **Ringold Street Site Investigation – Trenton, NJ**

Working with the Department of Housing and Development of the City of Trenton and the New Jersey Department of Environmental Protection, Ms. Miranda prepared a Remedial Investigation Work Plan and a Remedial Investigation Report for a 2-acre Brownfield site. Ms. Miranda conducted the site investigation at this former gasoline station to delineate the extent of subsurface contaminants and prepared a limited remedial feasibility study. Remedial actions to address PAHs and heavy metals detected at the site included hot spot removal and capping.

### **Superfund Technical Assessment and Response Team – Atlanta, GA**

Ms. Miranda prepared CERCLA Hazardous Ranking Scoring Strategies, conducted CERCLA Site Investigations and oversaw USEPA Emergency Response and Removals. As a member of the USEPA Hurricane Response Team, Ms. Miranda conducted oversight of emergency operation tasks and participated in helicopter over-flights of hazardous materials storage and treatment facilities following Hurricane Floyd's landfall in North Carolina.

### **SPECIALIZED TRAINING**

- OSHA 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) Training
- OSHA 8-Hour Supervisor HAZWOPER Training
- NYC Mayor's Office of Environmental Remediation (OER) Turbo-Training, Gold Certified, 2016
- Practical Applications in Hydrogeology, Rutgers University
- USEPA's All Appropriate Inquiry Rule, National Brownfields Association
- USEPA Region 4 Standard Operating Procedures for Field Sampling

- Hazard Ranking System Training Course

**PROFESSIONAL AFFILIATIONS**

- 2008-2009 Founding Board Member, 2008-2016 Brownfield Awards Committee Member, New York City Partnership of Brownfield Practitioners  
<http://www.brownfieldnyc.org/>

## **LINDSAY O'HARA, CHMM**

### **EDUCATION**

B.A., Environmental Studies, Union College, 2007

### **PROFESSIONAL REGISTRATIONS/CERTIFICATIONS**

Certified Hazardous Materials Manager, February 2015

### **AREAS OF EXPERTISE**

Ms. O'Hara possesses ten years of environmental consulting experience, primarily in connection with projects in New York City, encompassing:

- Project Management
- Environmental Site Assessments, Investigations and Audits
- Soil and Groundwater Investigation and Remediation
- Indoor Air Quality Assessments
- Ambient and Community Air Monitoring
- Remedial Activity Oversight and Management
- Hazardous Materials Building Inspections
- Regulatory Compliance

Ms. O'Hara's experience includes: Project management, comprehensive due diligence investigations and assessments, polychlorinated biphenyls (PCB) soil investigations and remediation, hazardous materials building assessments, remediation oversight, LNAPL remediation systems installation oversight and operation, groundwater monitoring well sampling, monitoring well/product gauging and LNAPL extraction, monitoring well installation oversight, soil sampling, development and implementation of community air monitoring plans (CAMP), and fuel release investigations. Ms. O'Hara serves as a Project Manager based in TRC's Milford, Connecticut office.

### **REPRESENTATIVE EXPERIENCE**

#### **New York City School Construction Authority**

Ms. O'Hara serves as a project manager (Contract Title: Associate Environmental Scientist) performing site assessments in support of new construction and renovations of New York City public schools. Responsibilities include Phase I Environmental Site Assessments, Phase II Environmental Site Investigations, Indoor Air Quality Investigations, and Outdoor Air Assessments. Ms. O'Hara's responsibilities have included all aspects of preparation of reports and all elements of field investigations, subcontractor supervision, and report preparation associated with completion of due diligence assessments. In this capacity, Ms. O'Hara has been the primary author of over 50 Phase I ESAs for the NYCSCA. Additionally, Ms. O'Hara is the current TRC lead for the Universal Pre-Kindergarten due diligence investigations in the borough of Queens.

Ms. O'Hara also served as Project Manager for tasks relating to investigations and remediation of polychlorinated biphenyl (PCB) contaminated soil at various New York City schools under an Asbestos, Lead, Mold & PCB Environmental Consulting Services Contract. Ms. O'Hara's project management responsibilities include daily communication and project coordination with NYCSCA and their contractors, supervision of field staff, and review of all work products including daily summary reports, laboratory results for excavation activities, Surface Soil Investigation Reports, PCB Soil Remediation Reports, and United States Environmental Protection Agency (EPA) Notification Letters.

### **The Port Authority of New York and New Jersey - Howland Hook Marine Terminal – Port Ivory Facility – Staten Island, New York**

Ms. O'Hara serves as Project Manager for environmental tasks associated with three Voluntary Cleanup Program (VCP) Sites at the Howland Hook Marine Terminal (HHMT) – Port Ivory Facility (VCP Site No. V00615-2 (Site 1), VCP Site No. V00674-2 (Site 2) and VCP Site No. V00675-2 (Site 3)). The approximately 123.75-acre HHMT-Port Ivory Site was formerly owned by Proctor and Gamble (P&G). P&G reclaimed the Site from marshland and improved the Site from 1906 to 1907. As a result of P&G's industrial land use from approximately 1908 to 1990, soil and groundwater were impacted by metals and organic compounds. Ms. O'Hara was responsible for remedial construction oversight during implementation of the Interim Remedial Work Plan for Site 3 which included excavation of petroleum-contaminated soil, the collection of post-excavation soil samples, post-excavation soil sampling, implementation of the CAMP, bi-weekly gauging activities including product removal, Site inspections, and annual landfill inspections. Additionally, Ms. O'Hara assisted the Port Authority's legal department by filing the required deed restrictions for Sites 1 and 2. Ms. O'Hara assumed responsibilities in connection with preparation of several reports for this Site, including the final Site Management Plans for Sites 1 and 2, the Final Engineering Reports for Sites 1 and 2, the Periodic Review Reports for Sites 1 and 2, the Interim Remedial Measure Work Plan and Remedial Action Work Plan for Site 3, Landfill Monitoring Summary Reports, and monthly progress reports.

### **NYSDEC, State Superfund-Related Projects – New York**

Ms. O'Hara assists in the management of site characterizations, remedial investigations, and feasibility studies for sites throughout New York State. Responsibilities include the preparation of work plans, project execution, client interaction, and report preparation.

### **United States Postal Service – New York**

Ms. O'Hara serves as Project Manager for tasks relating to environmental due diligence and indoor air quality investigations for USPS sites throughout New York State. Ms. O'Hara's responsibilities have included management of field staff and report preparation associated with completion of Phase I ESAs and Phase II ESIs.

**The Port Authority of New York and New Jersey – Red Hook Container Terminal - Brooklyn, New York**

Ms. O'Hara served as Project Manager for closure and removal of four 4,000-gallon underground storage tanks at the Red Hook Container Terminal in Brooklyn. Responsibilities included management of soil and groundwater sampling, contractor oversight, communication with NYSDEC Project Managers, and preparation of a UST Closure Report and a Remedial Action Work Plan to address the residual petroleum impacts to soil and groundwater. Additionally, Ms. O'Hara manages the remediation at this property, which includes the implementation of focused vacuum truck extraction and sulfate injection events, groundwater monitoring and analytical groundwater data management and review.

**National Grid – Long Island, New York**

Ms. O'Hara served as Senior Project Scientist for tasks relating to comprehensive environmental due diligence investigations for two Power Stations in Long Island, New York. Ms. O'Hara completed Phase I ESAs for an approximately 64-acre active electric generating station (the Port Jefferson Power Station) in Port Jefferson, New York and an approximately 127-acre active electric generating station (the E.F. Barrett Power Station) in the Town of Hempstead, New York. Ms. O'Hara completed the Site inspections at each facility and authored both reports.

**Civic Builders – New York City**

Ms. O'Hara serves as Project Manager for tasks relating to environmental due diligence, subsurface investigations, remediation design, and construction inspection services for Civic Builders, a developer of new charter schools in New York City. Ms. O'Hara has been responsible for preparation of Phase I ESA reports, Phase II ESI reports, Remedial Action Plans, and Construction Health and Safety Plans for proposed school sites, and has obtained required environmental approvals for charter school construction from the New York City Department of Environmental Protection, New York City Housing Authority, and New York City School Construction Authority. Additionally, Ms. O'Hara has managed environmental design and construction inspection services for new charter school construction.

**AIMCO – New York City**

Ms. O'Hara serves as Project Manager for an environmental services task order contract with a nationwide investor in multi-family housing. Ms. O'Hara's responsibilities include management and performance of environmental due diligence investigations, water quality testing, and radon sampling.

**Queens West Development – Stage 2 Site - Long Island City, NY**

Ms. O'Hara served as project scientist for environmental tasks for the remediation of Operable Units (OUs) 3 and 4 of the Queens West Development – Stage 2 Site (NYSDEC BCP Site Nos. C241095 and C241096) in Long Island City, Queens, NY. The site is an approximately nine-acre parcel which is the location of a former oil

refinery. Prior use of the property resulted in metals and petroleum-related contamination in soil and groundwater, including an approximately one-acre LNAPL plume. Ms. O'Hara was responsible for in-place waste characterization sampling, remedial construction oversight, installation of over 50 soil borings and collection and characterization of soil samples, supervision of the installation of over 50 groundwater monitoring wells, weekly LNAPL vacuum extraction oversight, monitoring well development, groundwater sampling, implementation of the CAMP, oversight of utility clearance utilizing ground penetrating radar (GPR), and all related reporting. Ms. O'Hara assumed project scientist responsibilities in connection with preparation of several reports for this Site, including the In-Situ Chemical Oxidation Pilot Test Report, a Post-Remediation Sampling Report, the Final Engineering Reports for OUs 3 and 4, and a Remedial Action Work Plan amendment.

**Consolidated Edison Company of New York, Inc., Newtown Substation - Long Island City, NY**

In support of the development by Consolidated Edison of the Newtown Substation site in New York, Ms. O'Hara collected and characterized soil samples for delineation purposes and in-situ waste characterization profiling to support a "load and go" scenario for future soil excavation and off-site transportation and disposal. Following the field work and in accordance with the regulatory agency-approved Remedial Action Work Plan (RAWP), Ms. O'Hara provided contractor oversight of three chemical oxidation injection events each consisting of 81 injection locations on-site to address residual petroleum impacts in the soil and groundwater. In addition, Ms. O'Hara performed low-flow groundwater sampling and managed the CAMP, monitoring well decommissioning, soil excavation activities, and construction of the groundwater remediation system. Following the implementation of the RAWP, Ms. O'Hara prepared the Final Engineering Report.

**Consolidated Edison Company of New York Inc., Rainey Substation - Long Island City, NY**

Ms. O'Hara provided environmental consulting services consisting of remediation oversight of excavation, post-excavation soil and groundwater sampling, and well pumping and gauging. Additionally, Ms. O'Hara coordinated subcontractor agreements for analytical testing. Upon completion of post-excavation sampling events and Site restoration, Ms. O'Hara prepared the Remedial Action Report.

**Consolidated Edison Various Spill Sites - Queens, Manhattan, Staten Island, Westchester County, NY**

Ms. O'Hara provided various environmental services to the Consolidated Edison Transmission Operations Department in support of spill investigations. Ms. O'Hara performed soil and groundwater sampling and report preparation in support of spill closure activities.

**Consolidated Edison Hudson Avenue Generating Station - Brooklyn, NY**

Ms. O'Hara served as project scientist for the preparation and implementation of a hazardous material inventory assessment. In the field, Ms. O'Hara recorded the description, location, and condition of regulated and hazardous building materials in support of proposed demolition. In addition, Ms. O'Hara collected samples of potentially hazardous materials, including paint chips, window caulking, liquid chemicals, solid chemicals, and dusts/residues, for laboratory analysis.

**SPECIALIZED TRAINING**

- OSHA 40-Hour HAZWOPER Training and 8-hour Refresher
- OSHA 10-Hour Construction Safety Training
- First Aid / CPR Certified



## **WES LINDEMUTH, CHMM, CSP**

### **EDUCATION**

B.S., Environmental Science, Kutztown University, December 2004

### **PROFESSIONAL REGISTRATION/CERTIFICATIONS**

IHMM – Certified Hazardous Materials Manager – CHMM (No. 15661), May 2011

BCSP – Certified Safety Professional – CSP (No. CSP-30429), September 2015

NYSDEC – Erosion and Sediment Control Training (No. 45T-012014-31), January 2014

### **AREAS OF EXPERTISE**

Mr. Lindemuth has experience in the following general areas:

- Project Management
- Environmental Assessment and Audit
- Remedial Investigation
- Remedial Construction Inspection and Management
- Underground Storage Tank Investigation and Management
- Environmental Health and Safety
- Hazardous Materials Building Inspections
- Indoor Air Quality Investigations
- Vapor Intrusion Assessments

Mr. Wes Lindemuth serves as a Senior Project Manager based in TRC's New York City office and has over 11 years of environmental consulting experience. Mr. Lindemuth has assumed progressively increasing responsibilities in environmental consulting. His experience includes project scoping, budgeting, management, implementation of site assessments and investigations, reporting, health and safety management and close out of large scale environmental projects as well as supervising and directing project staff.

Mr. Lindemuth has performed, reviewed and managed staff in connection with over 500 Phase I Environmental Site Assessments (ESAs) and 40 Phase II Environmental Site Investigations (ESIs) for residential, commercial, industrial, manufacturing and other properties throughout his career.

### **REPRESENTATIVE EXPERIENCE (Descriptions marked with an asterisk (\*) undertaken within past three years)**

#### **NYC School Construction Authority – New York, NY (2015 – Present)\***

Mr. Lindemuth serves as in-house consultant staff for the IEH Division and provides technical oversight, performs quality control reviews, and assist with coordination and management of the Local Law 12 (LL12) reporting program. Mr. Lindemuth provides



oversight and reviews of the reporting documentation provided by several prime environmental consulting firms which are contracted to provide environmental due diligence, remedial design and remedial construction phase services to the SCA. Mr. Lindemuth is responsible for review of LL12 reporting checklists, contextualized summaries and review of associated Phase I Environmental Site Assessments reports, Phase II Environmental Site Investigation reports, indoor air quality survey reports, remedial investigation reports, construction inspection reports, water disinfection reports, and evaluations of excavated material disposal plans for consistency with LL12 reporting checklists and contextualized summaries. Mr. Lindemuth is also responsible for the submission of notifications of “exceedances” of applicable regulatory criteria to the New York City Department of Education.

#### **NYC School Construction Authority – New York, NY (2006 – 2012)**

Mr. Lindemuth served as a Project Manager (Contract Title: Junior Environmental Scientist) providing consulting services in connection with proposed new construction, alteration, and leased sites to assess the suitability of the sites for use as public school facilities. Responsibilities included management of 25 Phase I ESAs, 15 Phase II ESIs, five Vapor Intrusion and Indoor Air Quality Investigations, four PCB remediation projects, three underground storage tank (UST) closures, four petroleum spill investigations, four Product Safety reviews, review of two excavated material disposal plans (EMDPs), preparation of state pollutant discharge elimination system (SPDES) permit applications, Long Island well permit applications, a chemical bulk storage tank closure plan, and assisted with obtaining New York City (NYC) Department of Environmental Protection (DEP) sewer use permits. Responsibilities included all aspects of scope of work and cost estimate preparation, client consultation, staff supervision, subcontractor supervision and work plan implementation, emergency response, and report writing including development of conclusions and recommendations.

#### **ProSource Technologies LLC – NYS Smart Home Buyout Program\***

Mr. Lindemuth served as a Project Manager providing consulting services in connection with pre-acquisition due diligence for Hurricane Sandy-impacted residential and commercial properties located throughout New York. Responsibilities included the management of the completion of nearly 400 Phase I ESAs, 1,045 Tier II Forms, 12 Phase II ESIs and implementation of Stormwater Pollution Prevention Plan (SWPPP) inspections. Responsibilities also included all aspects of scope of work and cost estimate preparation, attending client meetings, staff supervision, subcontractor supervision, work plan implementation, and report preparation.

#### **The City of New York Department of Parks and Recreation – New York City\***

Mr. Lindemuth serves as a Senior Project Manager providing consulting services in connection with the construction and reconstruction of park buildings and facilities in New York City. Responsibilities include investigation, remediation and reconstruction of several ballfields under the direction of the USEPA located within the 57-acre Red Hook Recreation Area. Responsibilities include all aspects of scope of work and cost estimate

preparation, client consultation, staff supervision, subcontractor supervision and work plan preparation and implementation, and report writing including development of conclusions and recommendations.

**Brookfield Office Properties – Manhattan West, New York, NY\***

Mr. Lindemuth served as a Project Manager responsible for managing the performance of environmental services in connection with the construction of a 69-story commercial tower at the Manhattan West redevelopment project enrolled in the New York City Office of Environmental Remediation (OER) Voluntary Cleanup Program (VCP). Services included interface with the OER and coordination from enrollment through completion of the VCP, performance of a soil vapor investigation, preparation of a Hazardous Materials Remedial Action Work Plan (RAWP), a Noise Remedial Action Plan (RAP) and an Air Quality RAP required as part of the VCP. Environmental services also included remediation oversight in connection with soil characterization sampling and excavation and off-site disposal of historic fill and hazardous waste. In addition, responsibilities included the management of a third party monitoring consultant in connection with lead abatement activities of the Dyer Avenue Bridge including interface with Port Authority and review of the abatement contractor lead compliance program and health and safety plan (HASp). The Site received a Notice to Proceed from OER in May 2015.

**Vornado Realty Trust – New York City\***

Mr. Lindemuth served as Project Manager responsible for the continuous performance of due diligence and environmental investigation services associated with acquisition, financial lending and redevelopment of over 25 properties located in NYC. Responsible for managing the performance of property inspections, remediation cost estimates, Phase I ESAs, Phase II ESIs and coordination with NYC OER in connection with Site redevelopment including Site investigations, preparation of Remedial Action Work Plans, and Remedial Action Reports.

**Two Trees Management Company – 60 Water Street, Brooklyn, NY\***

Mr. Lindemuth served as a Project Manager responsible for the implementation of a Remedial Action Work Plan in connection with the redevelopment of the 46,000-squarefoot NYC OER VCP site. Responsibilities included staff supervision during the oversight of the excavation and off-site disposal of approximately 33,000-cubic yards of historic fill and soil from the site, daily reporting to the NYC OER, collection of post-excavation endpoint soil samples, oversight of the removal of underground storage tanks, performance of inspections in connection with the installation of a passive sub-slab venting system, and preparation of a Remedial Action Report. The site received a notice of satisfaction from OER in December 2014.

**Two Trees Management Company – Domino Sugar Project, Brooklyn, NY\*** Mr. Lindemuth served as a Project Manager providing consulting services in connection with the large scale, mixed-use development project to redevelop the 11.1 acre plot of land the former Domino Sugar Refinery currently resides on. Responsibilities included

managing the development of several construction measure plans including dust control, noise control, soil erosion and sediment control, pest management, and air emission reduction measures. Responsible for implementing a groundwater monitoring program to comply with the NYSDEC regulations in connection with two 250,000-gallon No. 6 fuel oil underground storage tanks. In addition, managed and supervised staff during the performance of weekly inspections and submission of a monthly compliance report to the NYC Department of City Planning.

**SL Green Realty Corporation – Due Diligence - New York City\***

Mr. Lindemuth served as a Project Manager responsible for the performance of due diligence and environmental investigation services associated with acquisition, financial lending and redevelopment of over 25 properties located in NYC. Services provided include performance of property inspections, remediation cost estimates, Phase I ESAs, Phase II ESIs and one property enrolled in the New York State Brownfield Cleanup Program.

**BCRE – New York City\***

Mr. Lindemuth served as Project Manager responsible for managing the performance of OER related services associated with the redevelopment of two properties in NYC. Responsibilities included all aspects of the required coordination with OER including staff supervision during the preparation of Notices of No Objection, Site Investigation Work Plans, performance of Site Investigations, preparation of Site Investigation Reports and Remedial Action Work Plans.

**Artimus - 310 West 118th Street, Harlem, NY\***

Mr. Lindemuth served as a Project Manager responsible for closure of a NYSDEC spill case and satisfaction of the OER reporting in connection with the redevelopment of an EDesignation site which involved the removal of two underground storage tanks, excavation and off-site disposal of petroleum contaminated soil and historic fill, inspection of the installation of a vapor barrier, and preparation and approval of a OER Remedial Closure Report.

**HINES – 1 Vanderbilt, New York, NY\***

Mr. Lindemuth served as a Project Manager responsible for managing the performance of environmental services associated with the demolition of four buildings located adjacent to and west of Grand Central Station to allow construction of a 64-story commercial building. Responsibilities included supervising staff during the performance of a Site Investigation and associated reporting to the NYC DEP and OER.

**Gardiner and Theobald – Brooklyn Botanical Garden, Brooklyn, NY\***

Mr. Lindemuth served as a Project Manager responsible for providing environmental consulting services in connection with the implementation of enhancements at the Brooklyn Botanical Garden. Responsible for implementation of a soil investigation program and reporting associated with the NYC DEP City Environmental Quality Review

(CEQR) review process. Prepared a Construction Health and Safety Plan for use in connection with construction activities.

**Breeze Demolition Inc. – JFK International Airport, Queens, NY\***

Mr. Lindemuth served as a Project Manager responsible for managing the preparation of work plans associated with the demolition of Hangers 3, 4 and 5 located at the JFK Airport. Responsibilities included preparation of a Fire Safety Plan, Dewatering Plan and Soil Erosion and Sediment Control Plan for submittal for review and approval by the Port Authority.

**New York Families for Autistic Children – Queens, NY**

Mr. Lindemuth served as an Associate Project Manager providing environmental consulting services to the New York Families for Autistic Children (NYFAC) in connection with acquisition of a CEQR property located in Queens, New York. Services included the review of prior reports and regulatory correspondence (e.g., conditional negative declaration), performance of an Indoor Air Quality Survey, cleanout of two drywells, and a vapor intrusion survey. Responsibilities included all client coordination, proposal preparation, report preparation, and invoicing.

**Spectra Energy – NY/NJ Expansion**

Mr. Lindemuth served as an Associate Project Manager in connection with the construction of a natural gas pipeline from New Jersey to New York. The project consisted of the construction of approximately 20.3 miles of multi-diameter pipeline, associated pipeline support facilities, and six new metering and regulating stations. Mr. Lindemuth supervised a team of ten environmental inspectors performing oversight of construction activities including excavation and off-site disposal of non-hazardous and hazardous soil, treatment of groundwater prior to discharge to the ground surface or surface water body, spill reporting and cleanup, stormwater erosion and control inspection, worker health and safety oversight, and compliance with the Federal Energy Regulation Commission (FERC)-approved work plans. Responsibilities included team supervision, team health and safety oversight, review and distribution of daily reports, soil disposal management and tracking, and responding to client requests associated with construction operations.

**Turner Construction Company – MSK/CUNY Project, New York, NY\***

Mr. Lindemuth served as a Project Manager responsible for providing environmental risk management in connection with the redevelopment of a former department of sanitation property into a Memorial Sloan Kettering Cancer Center and City University of New York Campus. Responsibilities included subcontractor submittal review, staff supervision during soil and bedrock excavation oversight, manifest and hauler tracking, UST removal oversight, air and noise monitoring, and health and safety oversight.

**AIMCO, West Harlem Portfolio – Manhattan, NY**

Mr. Lindemuth served as a Senior Project Scientist responsible for performing preacquisition due diligence surveys for 95 apartment buildings located throughout the

Harlem neighborhood in Manhattan, New York for AIMCO, a real estate investment trust company. Responsibilities included preparation of Phase I ESA reports for each property as well as radon sampling and implementing several Phase II ESIs. Performed construction oversight for remediation projects including oversight of the removal of an underground storage tank system and oversight of in-situ chemical oxidation for groundwater remediation for AIMCO.

#### **GDF SUEZ, Astoria Energy Power Plant – Queens, NY**

Mr. Lindemuth served as an Article X Environmental Inspector working on behalf of Suez Energy (owner) in connection with the construction phase of a state-of-the-art Power Generating Facility in Astoria, NY. Article X Environmental Inspector responsibilities included verifying all construction activities and environmental measures were performed in compliance with the certificate conditions, as well as all federal, state and local statutes, ordinances, rules and regulations. Responsibilities also included client coordination, oversight of hazardous and non-hazardous waste tracking and disposal, SWPPP inspection, and health and safety compliance.

#### **Queens West Development Corporation – Queens, NY**

Mr. Lindemuth served as the Site Construction Manager in connection with the remediation of a nine acre designated Brownfield (NYSDEC BCP Site Nos. C241095 and C241096) site in Long Island City, Queens, NY. Supervised a team of four environmental professionals during the excavation of approximately 100,000 tons of soil under negative pressure enclosures (tents), removal of Light Non Aqueous Phase Liquid (LNAPL) via high vacuum extraction and implementation of an in-situ chemical oxidation pilot test using direct injection methods and a five foot diameter soil mixing/injection tool, postexcavation (end point) soil sampling, post-remediation groundwater well construction and sampling and soil vapor sampling. Supervised supplemental remediation activities including excavation of approximately 10,000 cubic yards of “grossly contaminated” soil below a lower permeability “peat” layer and the water table. Responsibilities included staff supervision and management of daily reporting to NYSDEC Region 2, oversight of excavation, dewatering, management of separate phase product, off-site transportation and disposal of excavated material, post-excavation sampling, procurement of clean soil backfill, backfilling of excavations and implementation of the site SWPPP, community air monitoring program, and health and safety oversight. A certificate of completion was issued by NYSDEC in December 2010.

#### **DHL Express USA – Due Diligence, Texas\***

Mr. Lindemuth served as a Project Manager in connection with the performance of due diligence activities associated with the evaluation of several commercial properties located in Texas. Responsibilities included managing and supervising staff during the performance of Phase I ESAs and preparation of recommendations in connection with potential environmental risk.



**NYC Economic Development Corporation – New York City**

Mr. Lindemuth served as an Assistant Project Manager in connection with seven Phase I ESAs, four Phase II ESIs, one hazardous material building inspection, an UST closure and two in-situ soil characterizations. Responsibilities included all aspects of preparation of Phase I ESA reports, all elements of Phase II ESI field investigations, confined space entry associated with the inspection of an underground storage tank vault, and preparation of two winning proposals for in-situ soil characterization. Additionally, responsible for the field inspection services in connection with the initial preparation of the Bush Terminal Landfill for development into a park. Responsibilities included inspection of dynamic compaction activities on the landfill, storm water management, soil gas sampling, and installation of groundwater monitoring well network.

**National Grid, Rockaway Park Former Manufactured Gas Plant (MGP) Site, – Queens, NY**

Mr. Lindemuth periodically served as the Site Health and Safety Manager in connection with the remediation of the 9.8-acre National Grid Rockaway Park Former Manufactured Gas Plant (MGP) Site located in Queens, NY. The remedial activities performed included the excavation of over 150,000 tons of contaminated soil under negative pressure enclosures (tents) for off-site disposal. Responsible for providing daily health and safety briefings (tool box talks), performing real time air monitoring in the exclusion zone, implementing the necessary personal protective equipment (PPE) level, performing daily and weekly Health and Safety Inspections, and ensuring all site workers were in full compliance with the approved Site Specific HASP.

**Stewart EFI – Yonkers, NY**

Mr. Lindemuth served as a Senior Project Scientist and field team leader in connection with the Site Investigation, Remedial Investigation and Remedial Alternative Analysis of NYSDEC VCP Site No. V00691-3 located in Yonkers, New York. The Site consisted of over four acres developed with two parking lots, a residential structure, and a 200,000 square foot industrial building formerly utilized for metal parts manufacturing from 1942 until 2008, when manufacturing operations ceased. Field team leader responsibilities included staff supervision and management of mapping of on-site floor drains and piping, oversight of a geophysical survey, and implementation of a soil and groundwater investigation program. Responsible for report preparation including formulating conclusions and recommendations, subcontractor coordination, laboratory analytical results review and comparison to applicable regulatory criteria, and coordination with the client and NYSDEC. TRC's client received a release and covenant not to sue letter from the NYSDEC in October 2011.

**Con Edison Inc. – New York City, NY**

Mr. Lindemuth served as a Senior Project Scientist for several subsurface investigations and hazardous materials building inspections at Consolidated Edison properties in New York. Served as a Project Scientist in connection with six hazardous material building inspections and two Phase II ESIs for Consolidated Edison properties. Responsibilities

included implementation of Phase II ESI field programs and inspections of former substations to identify hazardous materials and characterize building materials prior to planned demolitions.

**Pennsylvania Department of Environmental Protection, Wilkes-Barre, Harrisburg, Williamsport, PA – Engineering, Scientific & Technical Intern** **SPECIALIZED TRAINING**

- 4-Hour NYSDEC Erosion and Sediment Control Training, January 2014
- 8-Hour OSHA HAZWOPER Supervisor, August 2015
- 8-Hour OSHA HAZWOPER Refresher, March 2016
- 10-Hour OSHA Construction Safety Training, August 2015
- 30-Hour OSHA Construction Safety Training, September 2010
- 40-Hour OSHA HAZWOPER, August 2004
- Transportation Worker Identification Credential (TWIC)
- Secure Worker Access Credential (SWAC)

**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 <a href="mailto:aramirez@nycsca.org">aramirez@nycsca.org</a>
Mr. Srinivas Kanaparthi	Industrial Hygienist - C	NYCSCA 30-30 Thomson Ave. Long Island City, NY 11101	(718) 472-8620 <a href="mailto:skanaparthi@nycsca.org">skanaparthi@nycsca.org</a>



**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 44<sup>th</sup> 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

## **EMILY EBERT**

### **EDUCATION**

M.P.H., Environmental and Occupational Health Sciences, CUNY Graduate School of Public Health & Health Policy, 2021

B.S., Environmental Scientist, University of Vermont, 2013

### **PROFESSIONAL REGISTRATIONS/CERTIFICATIONS**

40-Hour HAZWOPER and current 8-Hour Refresher

OSHA 10-Hour Construction Safety Training

Transit Worker Identification Credential (TWIC) holder

### **AREAS OF EXPERTISE**

Ms. Emily Ebert, has project management and technical experience in the following general areas:

- Project Management
- Environmental Site Assessment and Investigation
- Environmental Regulatory Compliance
- Remedial Activity Oversight and Management
- Underground Storage Tank Closure
- 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

### **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 Bronx. Additionally, Ms. Ebert routinely provides recommendations and prepares Phase II Environmental Site Investigation Scopes of Work, which investigate all recognized environmental conditions identified during completion of the Phase I Environmental Site Assessment. Ms. Ebert's project management responsibilities include all aspects of Due Diligence program management, scope of work and cost estimate preparation and budget management, emergency response, and coordination and communication with NYCSCA project managers, TRC senior staff, contractors, and supervision of field staff.

Additionally, Ms. Ebert serves as a project manager for tasks relating to investigation and remediation of a Brownfield Cleanup Program (BCP) site in Brooklyn and for an E-designated

site in Manhattan. Ms. Ebert has also served as project scientist for management of remedial activities and IRMs for public school sites that are in the BCP, including authoring IRM work plans, RI reports, Remedial Action Work Plans (RAWPs), and Construction Completion Reports (CCRs).

Ms. Ebert has also served as a 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**

Ms. Ebert serves as a 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 80 properties located in New York City in support of the Learning Bridges project. Ms. Ebert's project management responsibilities included communication with NYCEDC project managers and building operators; supervision of field staff performing on-site sampling; review of analytical data generated; and preparation and review of all work products including daily summary emails and Indoor Air Quality Survey Letter Reports. The Surveys were completed within an expedited turnaround time.

Ms. Ebert also served as a project manager for tasks related to the St. George Ferry Landing Upland Scope for the Ballpark at St. George Stadium in Staten Island, NY. Ms. Ebert's responsibilities included coordination with contractors and NYSDEC; review of submittals for soil reuse and import; and, preparation of daily summary reports.

#### **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 – Multiple Sites – New York City**

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.

#### **MTA Long Island Rail Road – New York**

Ms. Ebert serves as a Project Manager performing due diligence assessments and investigation for Metropolitan Transportation Authority (MTA) Long Island Rail Road (LIRR). Ms. Ebert's responsibilities have included management and review of two (2) Phase I ESAs prior to site investigation activities. Ms. Ebert has assisted in managing remedial investigation activities associated with a spill and review of the RI report, leading to spill closure by the NYSDEC in May 2021. In addition, Ms. Ebert manages quarterly groundwater monitoring for a Site that is being remediated under a NYSDEC Order on Consent.

#### **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 ESAs, Phase I ESA updates, and Phase II 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. Additionally, Ms. Ebert served as project manager for underground storage tank (UST) investigation, UST removal, and spill closure activities at a proposed solar facility.

#### **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 prepared Remedial Investigation Work Plans and RI Reports for redevelopment projects enrolled in the New York City Office of Environmental Remediation (OER) Voluntary Cleanup Program.

#### **SPECIALIZED TRAINING**

- 40-Hour HAZWOPER and current 8-Hour Refresher
- OSHA 10-Hour Construction Safety Training
- Transit Worker Identification Credential (TWIC) holder



## **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/VPH 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 38<sup>th</sup> Street and East 40<sup>th</sup> 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





## Nancy Weaver

### Education

B.S., Chemistry, University of Colorado, Denver, Colorado

### Certifications and Training

State of New York Department of Environmental Conservation  
certified Asbestos Inspector

40-Hour OSHA Hazardous Waste Training

8-Hour Health and Safety Supervisor Training for Hazardous Waste  
Operations

### Relevant Experience

- More than 20 years combined laboratory, data validation and project management experience
- Experienced in writing Quality Assurance Project Plans (QAPPs), managing subcontracted analytical laboratories, performing laboratory audits, and analyzing samples in a laboratory.

### Experience Overview

Ms. Weaver has over twenty years combined laboratory, data validation and project management experience. She is the President and co-founder of EDS and is responsible for the technical data review and validation of laboratory data. Ms. Weaver has performed data validation on thousands of data validation projects. She has extensive knowledge in applying the various regional and project specific data validation guidelines and QAPPs. Her experience also includes writing Quality Assurance Project Plans (QAPPs), managing subcontracted analytical laboratories, performing laboratory audits, participating in field sampling activities and analyzing samples in a laboratory.

### Relevant Project Experience

Principal/Senior Chemist, Environmental Data Services, Inc., Williamsburg, Virginia, August 1994 - Present. As the Principal Chemist at Environmental Data Services, Inc., Ms. Weaver has provided Level IV data review on more than 6000 Sample Delivery Groups (SDGs) generated through site investigations and/or remediations. These SDGs have included every analytical fraction possible including VOC, SVOC, pesticides, PCBs, herbicides, DRO, GRO, dioxin/furans, PCB congeners, metals, wet chemistry and radiological parameters. Sample matrices include water, soil, sediment, wipe, concrete and air. The SDGs have included CLP data packages produced under the CLP SOWs and CLP-like data packages with samples analyzed under SW-864 methodologies. Sample quantities validated may reach upwards of 120,000 per fraction over the past 20 years. Ms. Weaver has been using the USEPA National Functional Data Validation Guidelines since 1993 and has provided Level IV (full) and Level III (cursory) validation. Specifically validated PCB congeners by EPA Method 1668 and dioxin/furans by EPA Method 1613 using the USEPA National Functional Guidelines, USEPA Region I and USEPA Region III data validation guidelines. Validated radiological parameters analyzed by alpha and gamma spectrometry using the USACE Kansas City and St. Louis District Radionuclide Data Quality Evaluation Guidance.

Chemist-Analyst Specialist, City & County of Denver, Denver, Colorado, June 1992 - August 1994. As a Chemist-Analyst Specialist for the City and County of Denver, Ms. Weaver supervised performance and compliance sampling for O & M requirements at groundwater treatment facility. She provided assessment of analytical data for quarterly reports to local regulatory agencies. She also acted as liaison between the technical group and laboratory to coordinate sampling events and resolve problems with analyses. While in this capacity, she performed data validation for organic, inorganic and radiological analyses. Ms. Weaver reviewed over 2000 VOC, SVOC, pesticide, PCB, TPH, metals and wet chemistry samples. Ms. Weaver managed the database for groundwater and treatment plant sampling events and performed environmental site assessments for commercial and residential properties. She provided technical review and recommendations of Phase I and Phase II site investigations performed by outside consultants. She also analyzed policy and interpreted city, state and federal environmental regulations.

Data Validation Specialist, C.C. Johnson & Malhotra, Lakewood, Colorado, January 1990 to June 1992. While a Data Validation Specialist at C.C. Johnson & Malhorta, Ms. Weaver performed data validation and interpretation of organic analytical data generated from the EPA Contract Laboratory Program (CLP). Data analysis included VOC,



SVOC, pesticides, PCBs, metals and wet chemistry. Ms. Weaver reviewed more than 600 SDGs and 9000 samples. She interpreted gas chromatograms, gas chromatography/mass spectral data and verified mathematical calculations.

Environmental Chemist, The Anschutz Corporation - SP Environmental Systems, Inc., Denver, Colorado, July 1990 to January 1992. As an Environmental Chemist for The Anschutz Corporation - SP Environmental Systems, Inc., Ms. Weaver assisted in the management of site investigations and remediation for Southern Pacific Transportation Company properties. In this capacity, she performed environmental audits and site assessments and conducted site investigations at potential Superfund sites with state and federal agencies. She researched and prepared responses to regulatory agencies for non-compliant sites and defined the needs for hazardous waste disposal including the analysis required and disposal. Ms. Weaver also supervised the removal of underground storage tanks and remediation. She prepared closure reports for UST removals, as well as annual waste summary forms for TSD facilities throughout the state of Texas. She also constructed, developed, and sampled groundwater monitoring wells.

Environmental Specialist, Martin Marietta Astronautics Group, Denver, Colorado, January 1988 to January 1990. While with Martin Marietta Astronautics Group as an Environmental Specialist, Ms. Weaver performed organic analysis and sampling of wastewater, groundwater, and drinking water in support of NPDES permit. She operated and maintained laboratory instrumentation including GC and GC/MS for volatile, semi-volatile, and pesticide/PCB analysis. Ms. Weaver also coordinated sample collection and preparation activities, developed and authored standard operating procedures for laboratory analysis, and followed EPA protocol for QA/QC requirements for analysis. She calculated and interpreted data and reported results.

Environmental Chemist, Camp, Dresser, & McKee, Boston, Massachusetts, April 1986 to October 1987. As an Environmental Chemist with Camp, Dresser, & McKee, Ms. Weaver analyzed water/wastewater for organic compounds. She operated and maintained laboratory instrumentation including GC and infrared spectrophotometer for volatile, pesticide/PCB, and petroleum hydrocarbon analysis. She also calculated and interpreted data and reported results. Ms. Weaver analyzed more than 2000 samples.

## Employment History

Environmental Data Services, Inc.	Principal/Senior Chemist	1994–Present
City & County of Denver	Chemist-Analyst Specialist	1992–1994
C.C. Johnson & Malhorta	Contractor/Data Validation Specialist	1990–1992
The Anschutz Corporation - SP Environmental Systems, Inc.	Environmental Chemist	1990–1992
Martin Marietta Astronautics Group	Environmental Specialist	1988–1990
Camp, Dresser, & McKee	Environmental Chemist	1986–1987