HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC
231 West 29th Street, Suite 1104
New York, New York 10001 USA
Tel: (631) 462-5866
Email: Info@hydrotechenvironmental.com
WWW.HYDROTECHENVIRONMENTAL.COM
USA – Middle East – North Africa

REMEDIAL INVESTIGATION WORK PLAN

601 – 607 Union Street

Block 434; Lots 1 & 12

Brooklyn, New York

Prepared For:	601 Union Street Owner LLC (a.k.a. Union Street Owner LLC) 221 West 37th Street New York, NY 10018
Prepared By:	HydroTech Environmental Engineering and Geology, DPC 231 West 29th Street Suite 1104 New York, New York 10001
Prepared On:	July 14, 2023
HydroTech Job No.	220073

CERTIFICATIONS

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

Mark E. Robbins, PG

Name

Signature

July 14, 2023

Date

LIST OF ACRONYMS

Acronym	Definition
AWQS	Ambient Water Quality Standards
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BGS	Below Grade Surface
BN	Base Neutral
CAMP	Community Air Monitoring Plan
C&D	Construction & Demolition
CGI	Combustible Gas Indicator
CPP	Citizen Participation Plan
DCE	Dichloroethene
DB	decibels
DUSR	Data Usability Summary Report
ESA	Environmental Site Assessment
ELAP	Environmental Laboratory Accreditation Program
FID	Flame Ionization Detector
EZ	Exclusion Zone
HASP	Health and Safety Plan
MDL	Method Detection Limit
NYC DEP	New York City Department of Environmental Protection
NYS DEC	New York State Department of Environmental Conservation
NYS DOH	New York State Department of Health

PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PID	Photo Ionization Detector
PFOA	Perfluorooctanoic acid
PM	Particulate Matter
PPE	personal protective equipment (PPE
QAO	Qualified Assurance Officer
QAPP	Quality Assurance Project Plan
QEP	Qualified Environmental Professional
QHHEA	Qualitative Human Health Exposure Assessment
QEP	Qualified Environmental Professional
REC	Recognized Environmental Condition
QA/QC	Quality Assurance/Quality Control
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
SCOs	Soil Cleanup Objectives
SCG	Standards, Criteria and Guidance
SCBA	Self-Contained Breathing Apparatus
SSO	Site Safety Officer
TAL	Full Target Analyte List
TCL	Full Target Compound List
TICs	Tentatively Identified Compounds
TOGS	Technical and Operational Guidance Series

SVOCs	Semi-Volatile Organic Compounds
USCS	Unified Soil Classification System
USGS	United States Geological Survey
VOCs	Volatile Organic Compounds

TABLE OF CONTENTS

Figures

Tables

Appendices

1.0 EXECUTIVE SUMMARY

This Remedial Investigation Work Plan (RIWP) has been prepared on behalf of Union Street Owners LLC (Volunteer) to document the details and protocols for the proposed environmental investigation of the property located at 601-607 Union Street, Brooklyn, New York (the "Site"). The purpose of this RIWP is to further investigate the environmental quality of on-site soil, groundwater, and soil vapor to fully characterize the nature and extent of contamination across the Site. The investigation work will be performed in accordance with the New York State Department of Environmental Conservation (NYSDEC) requirements set forth at 6 NYCRR 375-1.6 et seq., and in compliance with the New York State Department of Health (NYSDOH) Guidance for evaluating Soil Vapor Intrusion in the State of NY (October 2006, updated May 2017) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010, updated April 2019) and other acceptable industry standards. A BCP Application is being filed by the Applicant along with this RIWP to investigate and subsequently remediate the Site pursuant to a Brownfield Cleanup Agreement (BCA) that will be executed between Avdoo & Partners Development, LLC and the NYSDEC.

The investigation will be conducted through the installation and sampling of soil probes, sub-slab soil vapor probes and monitoring wells. All portions of the fieldwork will be conducted in accordance with the enclosed site-specific Health & Safety Plan.

The following sections provide the details and specific information pertaining to the various components of the RIWP.

2.0 INTRODUCTION

HydroTech Environmental Engineering and Geology, DPC ("HydroTech") has been retained by 601 Union Street Owner LLC (a.k.a. Union Street Owner LLC) to prepare this Remedial Investigation Work Plan (RIWP) for the property located at 601-607 Union Street in Bronx, New York (the "Site"). Specifically, this RIWP provides the protocols and specifications for the proposed subsurface investigation to fully characterize the environmental quality of the soil, groundwater, and soil vapor beneath the Site in anticipation of the Site remediation under the NYSDEC Brownfield Cleanup Program.

2.1 Site Description

The Site is located at 601-607 Union Street in the Gowanus section of Brooklyn, New York and is comprised of entire current Block 434 Lot 1 and Lot 12. The Site is bordered by Union Street, a 4-story mixed residential and commercial building and two 4-story residential buildings to the south, Third Avenue and an active construction site to the west, Sackett Street, two 2-story, one 3-story and one 1-story industrial/manufacturing buildings to the north and a commercial building with parking yard to east. Surrounding properties within one half mile radius of the Site consist of residential, industrial, institutional, commercial, vacant lands and transportation/utilities. **Figure 1** provides a Site Location Plan.

As part of the development, Lots 1 and 12 will be merged and the proposed development area will fully cover entire Lot 1 and Lot 12. The proposed development consists of two mixed residential and commercial use buildings in the western and southeastern portion and one commercial building in the northeastern portion occupying 70% of the merged lots and private yard occupying the remaining 30% area. The proposed building use will be consistent with the current zoning code (M1-4/R7A and M1-4). The development plan is still under preparation and no drawing is included in this application. The square footage of the proposed new development will be approximately 37,553 SF.

The current Lot 1 is fully developed with a 1-story building operating as a warehouse/office for a petroleum trucking and management company. These operations include on-Site truck repair and maintenance. A mezzanine level is maintained in the northeastern portion of the building and utilized as office space.

The building is primarily slab-on-grade, with a partial cellar in the northeast portion. The partial cellar is mostly covered with concrete slab with a small area excluded, which as per current owner's representatives consists of exposed soil due to historic tank removal or other limited soil intrusive work. One 3,000-gallon aboveground storage tank (AST) enclosed in concrete and one 550-gallon #2 AST with no enclosure were observed in the northwestern corner of the cellar. Both tanks are filled with #2 fuel oil. Light stains were observed in the concrete floor in the direct vicinity of the tanks. An oil/water separator is in the north central portion of the building and is in line with the sewer connection. The interior of the separator was unable to be accessed. A steel vent pipe is located through the roof along the northern wall of the building and is likely associated with the oil/water separator.

The current Lot 12 is utilized as open parking and storage yard and is covered with asphalt.

All site conditions remain the same as observed by HydroTech during Phase II Investigation in September 2022. **Figure 2** provides site details.

A Receptor Survey was performed within a ½-mile radius of the Site. The results of the sensitive receptor database search indicate there are schools/day cares/pre-Ks including JHS 051 William Alexander, Kids on Fifth, Inc., Rivendell School, Strong Place for Hope Day Care Center and Natalie's Sunflower LLC and Al Madinah School to the south, Eladia's Kids Parent LLC, PS 33 William A. Butler, Park Slope Christian Academy, Huggs Day School with Love, Inc., St. Francis Xavier, OST – St. Francis Xavier Parish, P.S. 282 Park Slope, OST – Imani House, Park Slope North Child Development Center Inc., Juguemos A. Cantar, LLC, Hellen Owen Carey Day Care Center, 21st Century – Benjamin Banneker Community Development and Ms 266 Park Place Community Ms to the east, Wyckoff Gardens Community Center, OST – YMCA of Greater NY/Dodge, P.S. 38 The Pacific, Acorn H.S. For Social Justice, Brooklyn H.S. For The Arts, Preschool of America (USA) Inc., St. Augustine School and Gowanus Community Center to the north, OST – Good Shepherd Services, New Horizons School, P.S. 32 Samuels Mills Sprole and P.S. 295 to the west. Other potential sensitive receptors include residential facilities situated in the immediate vicinities of the Site and Gowanus Canal to the west (>1,000 feet). No other sensitive receptors including schools, day care, hospitals, rivers or streams were identified within the search distance of 2,640 feet from the Site.

2.2 Site History

The following environmental assessments and investigations were previously performed at the Site and are provided as part of the BCP Application:

- Phase I Environmental Site Assessment by Athenica Environmental Services, Inc. dated July 11, 2022
- Phase II Environmental Site Assessment by HydroTech Environmental Engineering and Geology, DPC dated October 19, 2022

Based upon the Phase I ESA performed by Athenica Environmental Services, Inc. (Athenica) in July 2022, the Site was developed with one 2-story lumber shed on Lot 1 and several 4-story residential buildings on Lot 12 from as early as 1906. The existing 1-story building at Lot 1 was constructed prior to 1951. The residential buildings on Lot 12 were likely demolished between 1926 and 1951 and Lot 12 remained vacant since then.

The following Recognized Environmental Concerns (RECs) were identified at the Site:

- The E-Designation for the Site represents a REC since it pertains to potential hazardous materials.
- The historic and current industrial, manufacturing, auto repair and fuel oil storage/handling uses of the Site.
- The historic and/or current industrial, automotive service and gasoline station uses of the surrounding properties.
- NYSDEC spill #2009932 was reported on March 9, 2021 at 585 Union Street, which is approximately 50 feet to the west of the Site. Investigations identified impacts on soil and groundwater. This spill remains open.
- NYSDEC spill #9605719 was reported on August 2, 1996 at 204-222 4th Avenue, which is approximately 315 feet to the east of the Site.

Investigations identified contamination in soil vapor and groundwater. This spill remains open.

- The Potential Vapor Encroachment Condition (PVEC) from on-Site operations and off-Site properties with documented releases to soil vapor and groundwater.

No Controlled RECs (CRECs), or Historical RECs (HRECs) were identified at the Site.

A Phase II Environmental Site Assessment was performed by HydroTech Environmental Engineering and Geology, DPC (HydroTech) in September 2022. During the Phase II investigation, Ground Penetration Radar (GPR) survey was performed utilizing a GSSI SIR-3000 Control Unit and a 400-megahertz shielded antenna.

The GPR survey was conducted at approximately 80% of the Site while the remaining 20% were covered by goods/trucks or utilized as office space. In the accessible portion, an oil/water separator is identified in the mid-northern portion of the building. No other anomaly was observed during the survey. The survey also cleared all sampling locations of subsurface obstructions. A fill port was observed outside of the building on the sidewalk along Sackett Street. Both the oil water separator and fill port are marked in **Figure 2**.

The Phase II subsurface investigations consisted of the installation of seventeen (17) soil probes (designated as SP-1 through SP-17), eight (8) temporary wells (designated as MW-1 through MW-8), two(2) soil vapor probes (designated as SV-1 and SV-2) and five (5) sub-slab vapor probes (designated as SSB-1 through SSB-5) to access soil and soil vapor/sub-slab vapor impacts respectively at the Site. The results are documented in a draft Phase II

Environmental Site Assessment report dated October 19, 2022 prepared by HydroTech. **Figure 1** shows the previous location of investigation.

Soil

Acetone was detected in soil from SP-15 at 0.057 mg/kg slightly exceeding its respective Unrestricted Use Soil Cleanup Objectives (UUSCO). Acetone is commonly known as a laboratory contaminant and its exceedance should not be indicative of a release.

Chlorinated VOCs including 1,4-dichlorobenzene (3.4 mg/kg) in SP-11 (10-12 ft) and methylene chloride (max. 5.1 mg/kg) in SP-1 (8-10), SP-2 (8-10) and SP-6 (2-4 ft) were detected at concentrations exceeding their respective UUSCOs but less than their respective Restricted Soil Cleanup Objectives for Restricted Residential (RRSCOs). Petroleum VOC and its derivatives such as 1,2,4-trimethylbenzene (3.7 mg/kg), n-butylbenzene (25 mg/kg), n-propylbenzene (max. 29 mg/kg), sec-butylbenzene (22 mg/kg) and total xylene (1.1 mg/kg) in SP-10 (8-10 ft) and SP-11 (10-12 ft) were detected at concentrations exceeding their respective UUSCOs but below RRSCOs. No other VOCs were detected in any of the soil samples at concentrations exceeding UUSCOs. Total VOCs concentrations range from 0.014 mg/kg in SP-14 (6-8 ft) to 104.33 mg/kg in SP-11 (10-12 ft).

Various SVOCs, categorized as Polycyclic Aromatic Hydrocarbons (PAHs) including acenaphthene (23.8 mg/kg), benzo(a)anthracene (max. 40.5 mg/kg), benzo(a)pyrene (max. 54.8 mg/kg), benzo(b)fluoranthene (max. 21 mg/kg), benzo(k)fluoranthene (max. 28.2 mg/kg), chrysene (max. 43 mg/kg), dibenzo(a,h)anthracene (max. 4.41 mg/kg), fluoranthene (107 mg/kg), indeno(1,2,3-cd)pyrene (max. 24.9 mg/kg) and pyrene (183 mg/kg) were detected in SP-1 (8-10), SP-2 (8-10), SP-4 (4-6 ft), SP-6 (2-4 ft), SP-9 (1-3 ft), SP-12 (10-12 ft), SP-14 (6-8 ft), SP-15 (6-8 ft) and SP-16 (8-10 ft) at concentrations exceeding their respective UUSCOs. Except acenaphthylene, all the forementioned PAHs were also detected in most of the samples exceeding their respective RRSCOs and/or Restricted Soil Cleanup Objectives for Commercial use soil cleanup objectives as presented in 375-6.8(b) (RCSCOs). No other SVOCs were detected in any of the soil samples at concentrations exceeding UUSCOs. Concentrations of total SVOCs ranges from no detection in SP-5 (6-8 ft) to 671.98 mg/kg in SP-15 (6-8 ft).

Metals including arsenic (max. 106 mg/kg), barium (max. 4,910 mg/kg), copper (max. 181 mg/kg), lead (max. 2,400 mg/kg), nickel (max. 451 mg/kg), silver (max. 7.08 mg/kg), zinc (max. 2,980 mg/kg), mercury (max. 47.1 mg/kg) and chromium, trivalent (max. 109 mg/kg) were detected individually or collectively in all samples at concentrations exceeding their respective UUSCOs. Among the forementioned metals, the concentrations of lead in SP-4 (4-6 ft), SP-9 (1-3 ft), SP-11 (10-12 ft), SP-12 (10-12 ft) and SP-14 (6-8 ft) and mercury in SP-7 (0-2 ft), SP-11 (10-12 ft), SP-13 (10-12 ft) and SP-14 (6-8 ft) also exceed their respective RRSCOs; and the concentrations of arsenic in SP-3 (10-12), SP-7 (0-2 ft), SP-9 (1-3 ft), SP-12 (10-12 ft) and SP-13 (10-12 ft), barium in SP-6 (2-4 ft), SP-7 (0-2 ft), SP-9 (1-3 ft) and SP-12 (10-12 ft), lead in SP-3 (10-12), SP-6 (2-4 ft), SP-7 (0-2 ft), SP-10 (8-10 ft), nickel in SP-9 (1-3 ft), zinc in SP-6 (2-4 ft) mercury in SP-1 (8-10), SP-4 (4-6 ft), SP-9 (1-3 ft), SP-10 (8-10 ft), SP-12 (10-12 ft), SP-16 (8-10 ft) and SP-17 (4-6 ft) also exceed their respective RCSCOs. No other metals were detected at concentrations exceeding their respective regulatory standards.

PFAs including Perfluoroheptanoic acid (PFHpA), Perfluorohexanoic acid (PFHxA), Perfluoro-n-butanoic acid (PFBA) and Perfluorooctanoic acid (PFOA) were detected in SP-4 (4-6 ft), SP-6 (2-4 ft), SP-8 (1-3 ft), SP-12 (10-12 ft) and SP-13 (10-12 ft). Among the detected compounds, PFOA was found in SP-4 (4-6 ft) at a concentration of 1.62 ug/kg exceeding its respective NYSDEC Guidance Value for Unrestricted Use.

No pesticides, PCBs or 1,4-dioxane were detected above their respective Method Detection Limits (MDLs) in any soil samples.

In sum, various SVOCs and metals were found at concentrations exceeding RRSCOs and RCSCOs in shallow and deep soil within the proposed range of the mixed-use buildings and private courtyard in the western and southeastern portion as evidenced by the results of SP-4 and SP-6 through SP-17. SVOCs and metals were also detected at concentrations exceeding RCSCOs in the deep soil underneath the proposed commercial building in the northeastern portion as evidenced by the results of SP-1 through SP-3.

Figure 2 provides the map of VOCs, SVOCs and metals in soil. **Figure 3** provides the map of PFAs in soil.

Groundwater

Groundwater was encountered at approximately between 12.3 feet to 13.75 feet bgs. No evidence of free petroleum product was identified on the groundwater.

Benzene was detected in MW-7 at a concentration of 6.21 ug/L, which exceeds its GQS. No other VOCs were detected in any of the groundwater samples at concentrations exceeding their respective GQS.

SVOCs including benzo(a)anthracene (max. 0.36 ug/L), benzo(a)pyrene (max. 0.19 ug/L), benzo(b)fluoranthene (max. 0.16 ug/L), benzo(k)fluoranthene (max.

0.17 ug/L), chrysene (max. 0.37 ug/L) and indeno(1,2,3-cd) pyrene (max. 0.1 ug/L) were detected in MW-2, MW-3, MW-4, MW-7 and MW-8 at concentrations exceeding their respective GQS. No other SVOCs were detected in any of the groundwater samples at concentrations exceeding their respective GQS.

No pesticide was detected at concentrations exceeding their respective GQS. No PCBs were detected in any samples.

Various metals detected in groundwater samples. Among the detected metals, concentrations of dissolved metals including barium (max. 3,170 ug/L), chromium (max. 339 ug/L), copper (213 ug/L), lead (max. 9,230 ug/L), magnesium (max. 146,000 ug/L), manganese (max. 12,100 ug/L), nickel (max. 1,990 ug/L), sodium (max. 938,000 ug/L), zinc (max. 11,700 ug/L), antimony (max. 11.3 ug/L) and beryllium (max. 136 ug/L) exceeded their respective GQS in part of or all samples.

The compound 1,4-Dioxane was detected in MW-6 at a concentration of 1.54 ug/L, which exceeds its NYSDEC Guidance Value.

Several PFAs were detected in the groundwater samples including 1H,1H,2H,2H-Perfluorooctanesulfonic acid (6:2 FTS), Perfluorobutanesulfonic acid (PFBS), Perfluoroheptanoic acid (PFHpA), Perfluorohexanoic acid (PFHxA), Perfluoro-n-butanoic acid (PFBA), Perfluorooctanesulfonic acid (PFOS), Perfluorooctanoic acid (PFOA) and Perfluoropentanoic acid (PFPeA). The concentrations of PFOS (max. 0.042 ug/L) in MW-5 and MW-7 and PFOA (max. 0.070 ug/L) in all groundwater samples except from MW-8 are present at concentrations exceeding their respective NYSDEC Guidance Value.

Figure 4 provides the map of VOCs, SVOCs and metals in groundwater. **Figure 5** provides the map of PFAs and 1,4-dioxane in groundwater.

Soil Vapor and Sub-Slab Vapor

Both petroleum-range VOCs and chlorinated-range VOCs were detected in the soil vapor samples. The total concentrations of VOCs range from 109.7 ug/m^3 in SSB-4 to 2,141.7 ug/m^3 in SSB-6.

Chlorinated VOCs including 1,1-dichloroethane (3.9 ug/m^3), chloroethane (0.44 ug/m^3), chloroform (max. 4.2 ug/m^3), chloromethane (max. 2.3 ug/m^3), cis-1,2-dichloroethylene (max. 7.2 ug/m^3), dichlorodifluoromethane (max. 2.1 ug/m^3), methylene chloride (max. 5.2 ug/m^3), tetrachloroethylene (PCE) (max. 550 ug/m^3), trans-1,2-dichloroethylene (2.2 ug/m^3), trichloroethylene (TCE) (max. 240 ug/m^3) and trichlorofluoromethane (freon 11) (max. 1.2 ug/m^3) were detected individually or collectively in all vapor samples.

According to NYSDOH Soil Vapor/Indoor Air Matrix, the concentrations of cis-1,2-dichloroethene and TCE in SSB-1 and PCE in SSB-3 might either require no further action or require monitoring/mitigation in these locations. The concentrations of TCE (240 ug/m^3) and PCE in SSB-2 (550 ug/m^3) will require mitigation based upon the matrix. Note that indoor air samples were not performed.

Petroleum related VOCs including BTEX compounds (benzene, toluene, ethyl benzene and xylenes) and their derivatives were commonly detected in all vapor samples. The total concentration of BTEX compounds range from 13 ug/m^3 in SSB-1 to 152.1 ug/m^3 in SSB-3.

Figure 6 provides the map of VOCs in sub-slab vapor and soil vapor.

2.3 Environmental Setting

The Site is in northern portion of Brooklyn, New York. The elevation of the

Subject Property is approximately 18 feet above mean sea level (USGS 7.5-Minute Brooklyn, New York Quadrangle, 2013).

Brooklyn, New York is in the western portion of Long Island. Long Island consists of a wedge-shaped mass of unconsolidated deposits that overlie ancient basement rock.

The thickness of these deposits ranges from approximately 100 feet on the Island's north shore to approximately 2,000 feet in some portions of the south shore. These deposits contain ground water that is the sole source of drinking water for the Island's over 3.1 million residents.

The major landforms of Long Island of importance to the hydrologic system are the moraines and outwash plains, which originated from glacial activity. The moraines represent the farthest extent of the glacial advances. The moraines consist of till, which is a poorly sorted mixture of sand, silt, clay, gravel and boulders. The till is poor to moderately permeable in most areas. Outwash plains are located to the south of the moraines. The outwash plains were formed by the action of glacial melt water streams, which eroded the headland material of the moraines and laid down deposits of well-sorted sands, silts and gravels. These outwash deposits have a moderate to high permeability.

The Upper Glacial Aquifer is the uppermost hydrogeologic unit. This aquifer encompasses the moraine and outwash deposits, in addition to some localized lacustrine, marine and reworked materials. A relatively high horizontal hydraulic conductivity and a low vertical hydraulic conductivity characterize the outwash plain portion of this unit. Since the water table is situated in the Upper Glacial Aquifer.

The Magothy Formation directly underlies the Upper Glacial Aquifer in the vicinity of the site. This formation is a Cretaceous coastal-shelf deposit, which consists principally of layers of sand and gravel with some interbedded clay. This formation ranges from moderate to highly permeable. A clay layer in some parts of Long Island confines the uppermost portion of the aquifer. The Magothy is Long Island's principal aquifer for public water supply. The United States Environmental Protection Agency (USEPA) has classified the Long Island aquifer system as a sole source aquifer.

The Raritan Formation is the deepest unit and rests directly above the bedrock units. This formation is comprised of a sand member (Lloyd Aquifer) and a clay member (Raritan Clay). The Lloyd sand extends southward from Flushing Bay to the Atlantic Ocean. The thickness of the sand member ranges in depth from 200 to 800 feet below sea level and increases in thickness to the southeast. The clay member acts as an aquitard confining the lower Lloyd aquifer between the clay and the underlying bedrock.

According to the September 2022 investigation by HydroTech, groundwater was encountered from 12.30 to 13.75 feet below ground surface (bgs). According to the investigation performed at 585 Union Street (BCP Site #C224329) located on the west side of Third Avenue between Sackett Street and Union Street and less than 100 feet from the Subject Property, groundwater flow direction is toward the west-southwest, in the direction of Gowanus Canal.

2.4 Objective & Project Goals

The objective of this RIWP is to set forth the details and protocols for the further characterization of the environmental quality beneath the Site by further investigating the soil quality immediately above the water table and characterizing the soil/groundwater/vapor quality underneath the office area along western building perimeter, which was not accessible during the previous investigation.

All the fieldwork will be performed in accordance with 6NYCRR Part 375-3.8, along with NYSDEC DER-10 and applicable NYSDOH Guidance for Evaluating Soil Vapor Intrusion.

The existing building structure may be demolished to facilitate ease of access to perform certain portions of this RIWP. All demolition activities shall be performed in accordance with Federal, State, and local procedures and regulations.

Construction and demolition (C&D) debris, such as concrete, brick, or stone, may be disposed of at a NYSDEC registered or permitted recycling facility, or an active regulated construction and demolition debris municipal solid waste landfill that is permitted by the NYSDEC and which meets the current design standards for municipal solid waste facilities of 6 NYCRR Part 360.

C&D debris, such as concrete, brick, or stone, may be crushed on the subject property to generate recycled concrete aggregate (RCA) for temporary use in stabilized construction entrances and/or for creating stable surfaces on the subject property.

Before conducting any demolition activities, the existing building will be surveyed to confirm the presence of any asbestos-containing materials (ACBM) or lead-based paint (LBP). In the event ACBM or LBP is identified, the contractor shall take appropriate means to abate and dispose of the ACBM or LBP material in accordance with Federal, State, and local regulations.

3.0 INVESTIGATION SPECIFICATIONS

3.1 Introduction

The purpose of this section is to document the details and protocols intended to be utilized in the delineation of the contamination present on-site or emanating from adjacent properties, the determination of the site-specific groundwater flow direction and the general characterization of those portions of the Site that have yet not been investigated. To accomplish this, HydroTech will install and sample a series of additional soil probes, monitoring wells and soil vapor probes utilizing direct-push technology. Select soil, groundwater and soil vapor samples will be analyzed via approved analytical methods, and all laboratory results will be evaluated and documented in a Remedial Investigation Report. All these activities will be implemented consistent with a NYSDEC BCP Citizen Participation Plan (CPP) and in accordance with a site-specific Health and Safety Plan (HASP) and a Community Air Monitoring Plan (CAMP). Investigatory-derived waste soil and water generated during the investigation will be containerized in NYSDOT-approved 55-gallon drums and will be subject to waste characterization sampling consistent with disposal facilities requirements. **Appendix A** provides a Site-specific HASP. **Appendix B** provides a Site-specific CAMP.

Prior to the performance of the fieldwork, a public utility mark-out will be requested from the New York City-Long Island One-Call Center. All work will be coordinated with representatives of the NYSDEC.

3.2 Soil Probes

A total of seven (7) soil probes, designated SP-18 through SP-24, will be installed throughout the Site. Probe SP-19 through SP-21 will be installed in the western portion of existing building; SP-18 and SP-22 will be installed in the eastern portion of the existing building and SP-23 and SP-24 will be installed in the southern and northern half of the parking yard accordingly. The purpose of these soil probes is to characterize the soil quality underneath the western portion of the building and further characterize the soil quality at the soil-groundwater interface.

All soil probes will be installed utilizing a handheld Stanley PD45 Post Driver, which operates via direct-push (hydraulic percussion) technology and can be fitted with Geoprobe® tooling and sampling equipment and. **Figure 4** provides the proposed locations of the soil probes.

Soil sampling will comply with NYSDEC DER-10 3.5.2. Soil samples will be collected in all probes at 2-foot intervals utilizing a 4-foot Macro Core sampler fitted with dedicated acetate liners. The Macro sampler allows for the collection of discrete soil samples. Each sampler will be installed with 2½-inch diameter drill rods.

The probes will be extended to the soil-groundwater interface. Groundwater was encountered in the previous investigation, which was between 12.30 feet to 13.50 feet bgs. The soil samples will be placed in clean zip-lock storage bags and characterized in the field by a HydroTech geologist. The characterization will consist of field screening for evidence of organic vapors utilizing a Photoionization Detector (PID) with a 11.7eV bulb and soil classification.

Headspace analyses will be conducted on each soil sample by partially filling a zip lock bag and sealing it, thereby creating a void. This void is referred to as the sample headspace. To facilitate the detection of any hydrocarbons contained within the headspace, the container will be agitated for a period of thirty (30) seconds. The probe of the PID will then be placed within the headspace to measure the hydrocarbon concentrations present.

The soil classification will be based upon the Unified Soil Classification System (USCS). The USCS identifies common soil details such as grain size, shape, sorting and color. In addition, any visual or olfactory evidence of hydrocarbons will be identified. Soil probe logs will be generated based upon the soil characterization, along with the PID field screening. **Appendix C** provides a sample boring log.

Two (2) soil samples will be collected for lab analysis from each of the eight soil probes and will consist of the shallow sample from 2-foot interval below surface grade and from 2-foot interval above the soil-groundwater interface. A third sample will be collected if it exhibits a considerable level of hydrocarbons based upon the field screening results or will be collected from the historic fill layer if fill material was not intercepted in any of the prior two samples.

All soil samples collected for lab analysis will be containerized in laboratory supplied soil jars and appropriately labeled.

Table 1 - Summary of Proposed Soil Sampling Locations and Analyses

Soil Probe (SP)	Location	Soil Characterization Depth	Analytical Methods
SP-18	Eastern Half of Existing Building	* Sample from surface historic fill * Sample at the groundwater interface * Sample that contains the greatest level of hydrocarbons from surface fill layer and groundwater interface (if observed)	* TCL VOCs via EPA Method 8260 * TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury * Emerging Contaminants: - 1,4-Dioxane via Method 8270 SIM - 21 target Perfluorooctanoic acid (PFOA) via Modified EPA Method 537
SP-22			
SP-19	Area along Western Building Perimeter		
SP-20			
SP-21			
SP-23	Southern Half of Parking Yard		
SP-24	Northern Half of Parking Yard		

3.3 Groundwater Monitoring Wells

Three (3) of the soil probes (SP-19, SP-21 and SP-22) will be advanced and finished as temporary monitoring wells after soil sampling and designated as MW-9 through MW-11, respectively. The locations of the temporary monitoring wells are also shown on **Figure 4** – Proposed Sampling Plan. The monitoring wells are intended to characterize the groundwater quality underneath the western portion of the existing building and to determine the horizontal groundwater flow beneath the Site.

The temporary monitoring wells will be installed utilizing similar technology to the soil probes (i.e. direct push). All temporary monitoring wells will be constructed of 2-inch diameter PVC. The casing of each well will be appropriately labeled inside the manhole cover by attaching a water-resistant tag listing the well identification number. **Appendix D** provides a sample well construction log.

Once installed, all the temporary monitoring wells will be monitored and gauged for separate phase product. The monitoring will be performed utilizing a Solinst® 122 Oil/Water Interface Probe (Interface Probe). The Interface Probe can measure depths to water to 0.01 inch. The static depth to water will be measured in each well from the northern portion of the top of casing.

Following the well monitoring, the casing elevation of each well will be surveyed by a land surveyor licensed to practice in the State of New York. The determination of the casing elevation will allow for the calculation of the groundwater elevation beneath the site, which therefore allows for the determination of the groundwater flow direction. The groundwater elevations will then be imported into a computer-contouring program to determine the site-specific groundwater flow direction.

The monitoring wells will be purged and sampled in accordance with the USEPA's Region 1 Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (EQASOP #GW4, Rev. September 19, 2017) and following the stabilization of water quality indicator parameters. Sampling of groundwater will occur following the stabilization of aquifer parameters including pH, dissolved Oxygen, redox potential or ORP, temperature, specific conductance, and turbidity within specified confidence limits in the Quality Assurance Project Plan (QAPP) presented in **Appendix E**.

As per the USEPA's Low Stress/Flow Groundwater Sampling Protocol, static depth to water will also be gauged during the purging and sampling exercise.

Each groundwater sample will then be placed into laboratory supplied containers and appropriately labeled.

Table 2 - Summary of Proposed Temporary Groundwater Monitoring Well Sampling Locations and Analyses

Well ID	**Location**	**Analysis**
MW-9	Office Area along Western Building Perimeter	* TCL VOCs via EPA Method 8260
MW-10		

MW-11	Central portion of the building	* TCL SVOCs via EPA Method 8270 * Pesticides via EPA Method 8081 * Herbicides via EPA Method 8151 * Polychlorinated biphenyls via EPA Method 8082 * TAL Metals via EPA Method 6010 & EPA Method 7471 for Mercury * Emerging Contaminants: - 1,4-dioxane via EPA Method 8270D SIM - 21 target Perfluorooctanoic acid (PFOA) via Modified EPA Method 537

3.4 Sub-Slab Vapor Sampling

Three (3) sub-slab soil vapor sampling points, designated SSB-6 through SSB-8 will be installed at the Site in accordance with the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York (October 2006). Specifically, these probes will be installed throughout the office space inside the building, which was not accessible for testing during the previous Phase II investigation. Previous **Figure 7** provides the proposed location of sub-slab vapor sampling points.

The vapor sampling point will be installed utilizing similar technology to the soil probes (i.e., direct push). Each vapor sampling point will consist of a stainless-steel screen or implant fitted with inert polyethylene tubing of ¼ inch diameter and of laboratory quality to the surface. The sub-slab vapor implants will be installed to approximately 3 inches below the building slab.

Porous inert backfill material (e.g. glass beads) will be used to create a sampling zone around the stainless-steel screen or implant. The soil vapor points will be sealed above the sampling zone with a bentonite slurry to prevent outdoor air infiltration and the remainder of the borehole will be backfilled with clean material. The soil vapor probes will be finished to grade with a bentonite seal at surface.

Soil vapor samples from each soil vapor probe will be collected utilizing 6 liter pre-cleaned, passivated, evacuated whole air Summa® Canister. A 60-cm^3 plastic syringe will be used to purge approximately 1 to 3 implant volumes (i.e. the volume of the sample probe and tube) prior to collecting the soil vapor samples. Each air sampling canister will then be connected to a flow control valve set to collect the 6-L sample over a period of 4 hours at a rate of less than 0.2 liter per minute. To ensure the integrity of the borehole seal and to verify that ambient air is not inadvertently drawn into the sample, a tracer gas, such as Helium, will be applied to enrich the atmosphere in the immediate vicinity of the sampling location. A portable monitoring device MGD-2002 Helium-Hydrogen Lead Detector; Model 83-219, will be utilized to analyze a real time sample of soil vapor from each soil vapor sampling point for the tracer prior to purging and after sampling. Plastic sheeting will be used to keep the tracer gas in contact with the soil vapor point during the sampling.

Table 3 - Summary of Proposed Soil Vapor Sampling Locations and Analyses

Vapor Samples (SV/SSB)	Location	Analysis
SSB-6	Office Area along Western Building Perimeter	VOCs via EPA Method TO-15
SSB-7		
SSB-8		

3.5 Field Management of Investigation Derived Waste

Soil and Groundwater Sampling

- Soil cuttings generated during soil probe installation and sampling will be placed into 55-gallon drum(s) and properly disposed of.
- Fluids generated during groundwater sampling and equipment decontamination will be contained in the 55-gallons drums and properly disposed of as hazardous waste.
- Fine grade sand will be applied immediately around the boreholes to prevent any runoff of storm water from discharging unknown surface contaminants into the subsurface soil and groundwater. The sand will be disposed of into 55-gallons drum(s) along the soil cuttings.
- The 55-gallon drum containing IDW will be temporarily staged in a secure area on-site at grade level and beneath the unfinished building until waste

characterization sampling is complete and arrangements with permitted disposal facility are finalized for. All boreholes will be backfilled with fine grade sand and properly sealed in surface with a layer of slurry and native shallow dirt.

3.6 Laboratory Analytical Methods

As indicated in **Table 1** and **Table 2** all soil and groundwater samples will be analyzed for volatile organic compounds (VOCs) via EPA Method 8260, semi-volatile organic compounds (SVOCs) via EPA Method 8270, Pesticides via EPA Method 8081, Herbicides via EPA Method 8151, Polychlorinated biphenyls via EPA Method 8082 and TAL Metals via EPA Method 6010 and EPA Method 7471 for Mercury. Groundwater samples analysis for TAL Metals will be performed for both filtered and unfiltered samples. Soil and groundwater samples will also be analyzed for Emerging Contaminants, i.e. 1,4-Dioxane via EPA Method 8270D SIM and the 21 target Perfluorooctanoic acid (PFAS) compounds via Modified EPA Method 537. As indicated in **Table 3** sub-slab soil vapor samples will be analyzed for VOCs via EPA Method TO-15.

3.7 Quality Assurance/Quality Control

A HydroTech Quality Assurance Officer (QAO) (Ruijie Xu) will adopt a Quality Assurance Project Plan (QAPP) during the collection of soil, groundwater, and soil vapor samples in order to ensure that proper procedures are performed and subsequently followed during sample collection and analysis. The QAPP for this investigation is provided in **Appendix E**.

4.0 REPORT OF FINDINGS

A Remedial Investigation Report (RIR) will be prepared following the completion of the fieldwork and the laboratory analyses in accordance with DER-10 Section 3.14. This report will be certified by a QEP as per DER-10 Table 1.5 and will contain the findings and conclusions of the investigation and will include appropriate maps and diagrams, tabulations of all analytical data, written narratives, boring logs and well construction diagrams, well purging and sampling logs, and appendices.

The soil quality results will be compared to the 6 NYCRR Part 375 Unrestricted Residential Use and Restricted Residential Use. The groundwater quality results will be compared to the AWQS documented in NYSDEC's Technical and Operational Guidance Series (TOGS) 1.1.1. All soil samples that exceed their respective soil cleanup objectives (SCOs) and groundwater samples that exceed the Ambient Water Quality Standards (AWQS) will be highlighted in tables and shown on spider diagrams. The RIR will include the Data Usability Summary Report. Based on the results of this phase of remedial investigation, further delineation of the groundwater and soil vapor contamination may be required.

All data will also be submitted electronically to NYSDEC through the Environmental Information Management System, using the standardized electronic data deliverable (EDD) format.

4.1 Anticipated Project Schedule

The table below provides a tentative schedule for the performance of the remedial investigation and other major tasks leading to the date of issuance of a Certificate of Complete (COC). This schedule is tentative based upon the approvals of documents by the NYSDEC. Demolition of the existing buildings will be performed in compliance with all applicable laws, rules and regulations from NYC Department of Building (DOB) and Fire Department of NYC. Prior to demolition, pre-demolition inspection and/or abatement for asbestos-containing materials will be performed by certified personnel. The demolition shall be performed by State licensed contractor supervised by NYCDOB and Fire Department of NYC to verify the appropriate protocols are followed and to ensure compliance with fire safety standards. The demolition debris will be properly disposed of at a State certified disposal facility.

Table 4 - Summary of Anticipated Project Schedule

Schedule Milestone	Anticipated Date
Brownfield Cleanup Agreement Signed	July 2023
Submit Citizen Participation Plan (CPP)	July 2023
NYSDEC Approval of RIWP	August 2023
Implementation RIWP	August/September 2023
Submit RIR/RAWP	October/November 2023
Fact Sheet Announcing the 45-day Public Comment Period for RAWP Activities	December 2023/January 2024
NYSDEC RAWP Approval/ Issuance of Decision Document	February 2024

Begin Implementation of Remedial Action	March 2024

FIGURES

PROPOSED BCP SITE BOUNDARY

nyc oasis

This map was created using the Open Accessible Space Information System (OASIS) website, licensed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 United States License. Visit www.oasisnyc.net for the latest information about data sources and notes about how the maps were developed. Contact oasisnyc@gc.cuny.edu with questions or comments. OASIS is developed and maintained by the Center for Urban Research, CUNY Graduate Center.

Legend

Transit, Roads, Reference Features

Roads, ferries, commuter rail, neighborhood names

Roads	Neighborhood/Town Labels
Major Roads	County Boundaries
Interstate Highways	Ferry
Tunnels	Commuter Rail

NYC subway routes and stations

Parks, Playgrounds, & Open Space

- 🟩 Parks & Public Lands
- 🟩 Forested Areas (NJ)
- 🟩 Community Gardens
- ▨ School property with garden
- 🟩 Playgrounds
- 🟩 Green Spaces Along Streets
- 🟩 Golf Courses
- 🟫 Baseball/Soccer/Football Fields
- 🟪 Tennis/Basketball/Handball Courts & Tracks
- 🟨 Cemeteries

Land Use

Block/Lot Boundaries

▥ (Building footprints in gray ▭)

- 🟨 1 & 2 Family Residential
- 🟨 Multi-family Residential
- 🟧 Mixed Use
- 🟩 Open space & outdoor recreation
- 🟥 Commercial
- 🟦 Institutions
- 🟪 Industrial
- 🟫 Parking
- 🟪 Transportation / Utilities
- 🟫 Vacant Lots

(Not all items in the legend may be visible on the map.)

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

TEL: (631) 462-5866

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS

601-607 UNION STREET,
BROOKLYN

PROJECT FIGURE

FIGURE 1: SITE LOCATION PLAN

PROJECT NO. 220073	DATE 7/4/2023
DRAWN BY N.P.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.

LEGEND:

●	LOCATION OF HISTORIC SOIL PROBES (SP-)
■	LOCATION OF HISTORIC SOIL PROBES/TEMPORARY MONITORING WELLS (SP-/MW-)
▲	LOCATION OF HISTORIC SOIL VAPOR PROBES (SV-) OR SUB-SLAB VAPOR PROBES (SSB-)
○	LOCATION OF EXISTING MONITORING WELL INSTALLED BY OTHERS

NOTE:
CELLAR SHAPE IS ESTIMATED
AND NOT TO SCALE

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL
ENGINEERING AND GEOLOGY,
DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

TEL: (631) 462-5866

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS

601-607 UNION STREET,
BROOKLYN

PROJECT FIGURE

FIGURE 2: SITE AND PREVIOUS INVESTIGATION PLAN

PROJECT NO. 220073	DATE 7/6/2023
DRAWN BY G.T.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.

SAMPLE ID	SP-11 (10-12)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
VOCs	mg/kg	mg/kg	mg/kg	mg/kg
1,4-Dichlorobenzene	3.40	1.8	13	130
n-Butylbenzene	25.0	12	100	500
n-Propylbenzene	29.0	3.9	100	500
sec-Butylbenzene	22.0	11	100	500
Xylenes, Total	1.10	0.26	100	500
TOTAL VOCs	104.33	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Copper	111	50	270	270
Lead	446	63	400	1000
Zinc	101	109	10000	10000
Mercury	0.99	0.18	0.81	2.8

SAMPLE ID	SP-12 (10-12)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/8/2022			
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)anthracene	4.31	1	1	5.6
Benzo(a)pyrene	4.41	1	1	1
Benzo(b)fluoranthene	2.62	1	1	5.6
Benzo(k)fluoranthene	2.55	0.8	3.9	56
Chrysene	4.12	1	3.9	56
Dibenzo(a,h)anthracene	1.49	0.33	0.33	0.56
Indeno(1,2,3-cd)pyrene	1.49	0.5	0.5	5.6
TOTAL SVOCs	54.70	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	20.7	13	16	16
Barium	677	350	400	400
Copper	57.7	50	270	270
Lead	740	63	400	1000
Zinc	236	109	10000	10000
Mercury	10.8	0.18	0.81	2.8

SAMPLE ID	SP-7 (0-2)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	106	13	16	16
Barium	1090	350	400	400
Copper	102	50	270	270
Lead	1690	63	400	1000
Zinc	470	109	10000	10000
Mercury	1.58	0.18	0.81	2.8
Chromium, Trivalent	49.6	30	180	1500

SAMPLE ID	SP-8 (1-3)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Lead	78.6	63	400	1000
Nickel	70.7	30	310	310
Zinc	118	109	10000	10000

SAMPLE ID	SP-10 (8-10)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
VOCs	mg/kg	mg/kg	mg/kg	mg/kg
1,2,4-Trimethylbenzene	3.70	3.6	52	190
n-Propylbenzene	5.40	3.9	100	500
TOTAL VOCs	26.81	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Lead	1870	63	400	1000
Zinc	977	109	10000	10000
Mercury	6.22	0.18	0.81	2.8

SAMPLE ID	SP-9 (1-3)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)pyrene	1.53	1	1	1
Benzo(b)fluoranthene	1.32	1	1	5.6
Benzo(k)fluoranthene	1.33	0.8	3.9	56
Dibenzo(a,h)anthracene	0.34	0.33	0.33	0.56
Indeno(1,2,3-cd)pyrene	1.01	0.5	0.5	5.6
TOTAL SVOCs	7.76	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	43.2	13	16	16
Barium	550	350	400	400
Copper	181	50	270	270
Lead	688	63	400	1000
Nickel	451	30	310	310
Zinc	425	109	10000	10000
Mercury	47.1	0.18	0.81	2.8
Chromium, Trivalent	109	30	180	1500

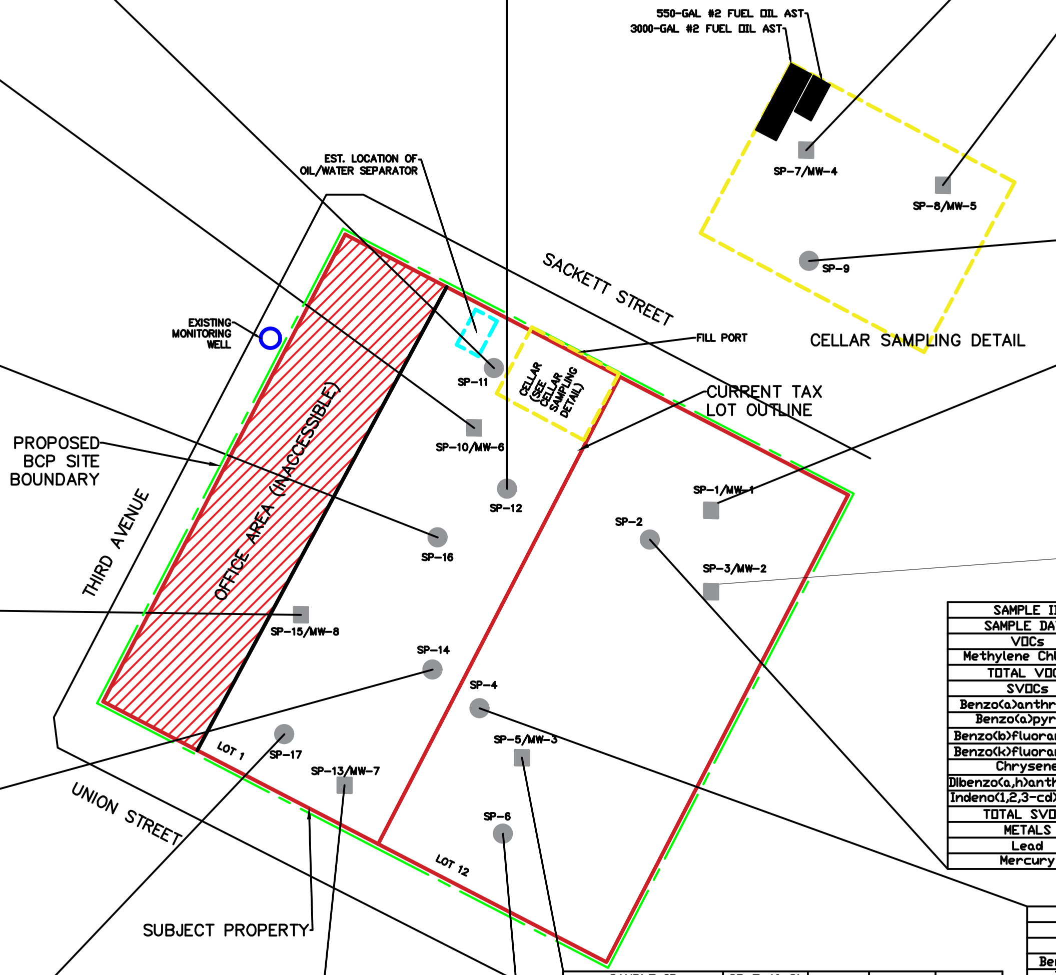
SAMPLE ID	SP-16 (8-10)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/8/2022			
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)anthracene	30.3	1	1	5.6
Benzo(a)pyrene	25.2	1	1	1
Benzo(b)fluoranthene	17.0	1	1	5.6
Benzo(k)fluoranthene	20.4	0.8	3.9	56
Chrysene	26.8	1	3.9	56
Dibenzo(a,h)anthracene	3.77			
Indeno(1,2,3-cd)pyrene	12.8	0.5	0.5	5.6
TOTAL SVOCs	397.29	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Lead	296	63	400	1000
Mercury	12.0	0.18	0.81	2.8

SAMPLE ID	SP-1 (8-10)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/8/2022			
VOCs	mg/kg	mg/kg	mg/kg	mg/kg
Methylene Chloride	5.10	0.05	100	500
TOTAL VOCs	5.58	NS	NS	NS
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)anthracene	3.79	1	1	5.6
Benzo(a)pyrene	2.85	1	1	1
Benzo(b)fluoranthene	2.25	1	1	5.6
Benzo(k)fluoranthene	2.34	0.8	3.9	56
Chrysene	3.72	1	3.9	56
Dibenzo(a,h)anthracene	0.45			
Indeno(1,2,3-cd)pyrene	1.13	0.5	0.5	5.6
TOTAL SVOCs	61.38	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Lead	196	63	400	1000
Mercury	3.29	0.18	0.81	2.8

SAMPLE ID	SP-15 (6-8)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/8/2022			
VOCs	mg/kg	mg/kg	mg/kg	mg/kg
Acetone	0.057	0.05	100	500
TOTAL VOCs	0.074	NS	NS	NS
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Acenapthene	23.8	20	100	500
Benzo(a)anthracene	40.5	1	1	5.6
Benzo(a)pyrene	54.8	1	1	1
Benzo(b)fluoranthene	21.7	1	1	5.6
Benzo(k)fluoranthene	28.2	0.8	3.9	56
Chrysene	43.0	1	3.9	56
Dibenzo(a,h)anthracene	4.41	0.33	0.33	56
Fluoranthene	107	100	100	500
Indeno(1,2,3-cd)pyrene	24.9	0.5	0.5	5.6
Pyrene	183	100	100	500
TOTAL SVOCs	671.98	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Silver	3.66	2	180	1500
Mercury	0.58	0.18	0.81	2.8

SAMPLE ID	SP-3 (10-12)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	21.9	13	16	16
Lead	1560	63	400	1000
Zinc	496	109	10000	10000
Mercury	0.51	0.18	0.81	2.8

SAMPLE ID	SP-2 (8-10)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
VOCs	mg/kg	mg/kg	mg/kg	mg/kg
Methylene Chloride	0.11	0.05	100	500
TOTAL VOCs	0.11	NS	NS	NS
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)anthracene	2.98	1	1	5.6
Benzo(a)pyrene	2.69	1	1	1
Benzo(b)fluoranthene	2.49	1	1	5.6
Benzo(k)fluoranthene	2.21	0.8	3.9	56
Chrysene	3.16	1	3.9	56
Dibenzo(a,h)anthracene	0.49			
Indeno(1,2,3-cd)pyrene	1.41	0.5	0.5	5.6
TOTAL SVOCs	61.38	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Lead	48.38	63	400	1000
Mercury	0.66	0.18	0.81	2.8



SAMPLE ID	SP-14 (6-8)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/8/2022			
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)anthracene	1.65	1	1	5.6
Benzo(a)pyrene	1.56	1	1	1
Benzo(b)fluoranthene	1.15	1	1	5.6
Benzo(k)fluoranthene	1.23	0.8	3.9	56
Chrysene	1.52	1	3.9	56
Indeno(1,2,3-cd)pyrene	0.68	0.5	0.5	5.6
TOTAL SVOCs	17.37	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Lead	763	63	400	1000
Mercury	2.04	0.18	0.81	2.8

SAMPLE ID	SP-4 (4-6)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)anthracene	1.40	1	1	5.6
Benzo(a)pyrene	1.26	1	1	1
Benzo(b)fluoranthene	1.01	1	1	5.6
Benzo(k)fluoranthene	0.95	0.8	3.9	56
Chrysene	1.38	1	3.9	56
Indeno(1,2,3-cd)pyrene	0.58	0.5	0.5	5.6
TOTAL SVOCs	61.38	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	14.3	13	16	16
Copper	139	50	270	270
Lead	743	63	400	1000
Nickel	76.3	30	310	310
Silver	7.08	2	180	1500
Zinc	249	109	10000	10000
Mercury	3.10	0.18	0.81	2.8
Chromium, Trivalent	30.7	30	180	1500

SAMPLE ID	SP-5 (6-8)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Nickel	46.5	30	310	310

SAMPLE ID	SP-17 (4-6)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/8/2022			
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Lead	103	63	400	1000
Mercury	3.28	0.18	0.81	2.8

SAMPLE ID	SP-13 (10-12)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/8/2022			
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	19.6	13	16	16
Copper	50.9	50	270	270
Lead	377	63	400	1000
Zinc	296	109	10000	10000
Mercury	2.31	0.18	0.81	2.8

SAMPLE ID	SP-6 (2-4)	UUSCOs	RRSCOs	RCSCOs
SAMPLE DATE	9/7/2022			
VOCs	mg/kg	mg/kg	mg/kg	mg/kg
Methylene chloride	0.084	0.05	100	500
TOTAL VOCs	0.084	NS	NS	NS
SVOCs	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)pyrene	1.43	1	1	1
Benzo(k)fluoranthene	0.84	0.8	3.9	56
Indeno(1,2,3-cd)pyrene	0.62	0.5	0.5	5.6
TOTAL SVOCs	9.80	NS	NS	NS
METALS	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	13.3	13	16	16
Barium	4910	350	400	400
Lead	2400	63	400	1000
Zinc	2980	109	10000	10000
Mercury	0.40	0.18	0.81	2.8

LEGEND:

● LOCATION OF HISTORIC SOIL PROBES (SP–)

■ LOCATION OF HISTORIC SOIL PROBES/TEMPORARY MONITORING WELLS (SP–/MW–)

○ LOCATION OF EXISTING MONITORING WELL INSTALLED BY OTHERS

NS = NO STANDARD AVAILABLE FOR TARGET ANALYTE

▨ SAMPLE EXCEEDS NYSDEC PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES (UUSCOs)

🟦 SAMPLE EXCEEDS NYSDEC PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES – RESTRICTED RESIDENTIAL (RRSCOs)

🟨 SAMPLE EXCEEDS NYSDEC PART 375 RESTRICTED USE SOIL CLEANUP OBJECTIVES – COMMERCIAL (RCSCOs)

NOTE:
1. CELLAR SHAPE IS ESTIMATED AND NOT TO SCALE

2. ALL SAMPLES WERE ANALYZED FOR VOCs, SVOCs, METALS, PCBs AND PESTICIDES. ONLY THE COMPOUND(S) EXCEEDING RESPECTIVE REGULATORY STANDARD(S) ARE MAPPED ON THIS PLAN.

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

TEL: (631) 462–5866

BASE DRAWING PREPARED BY

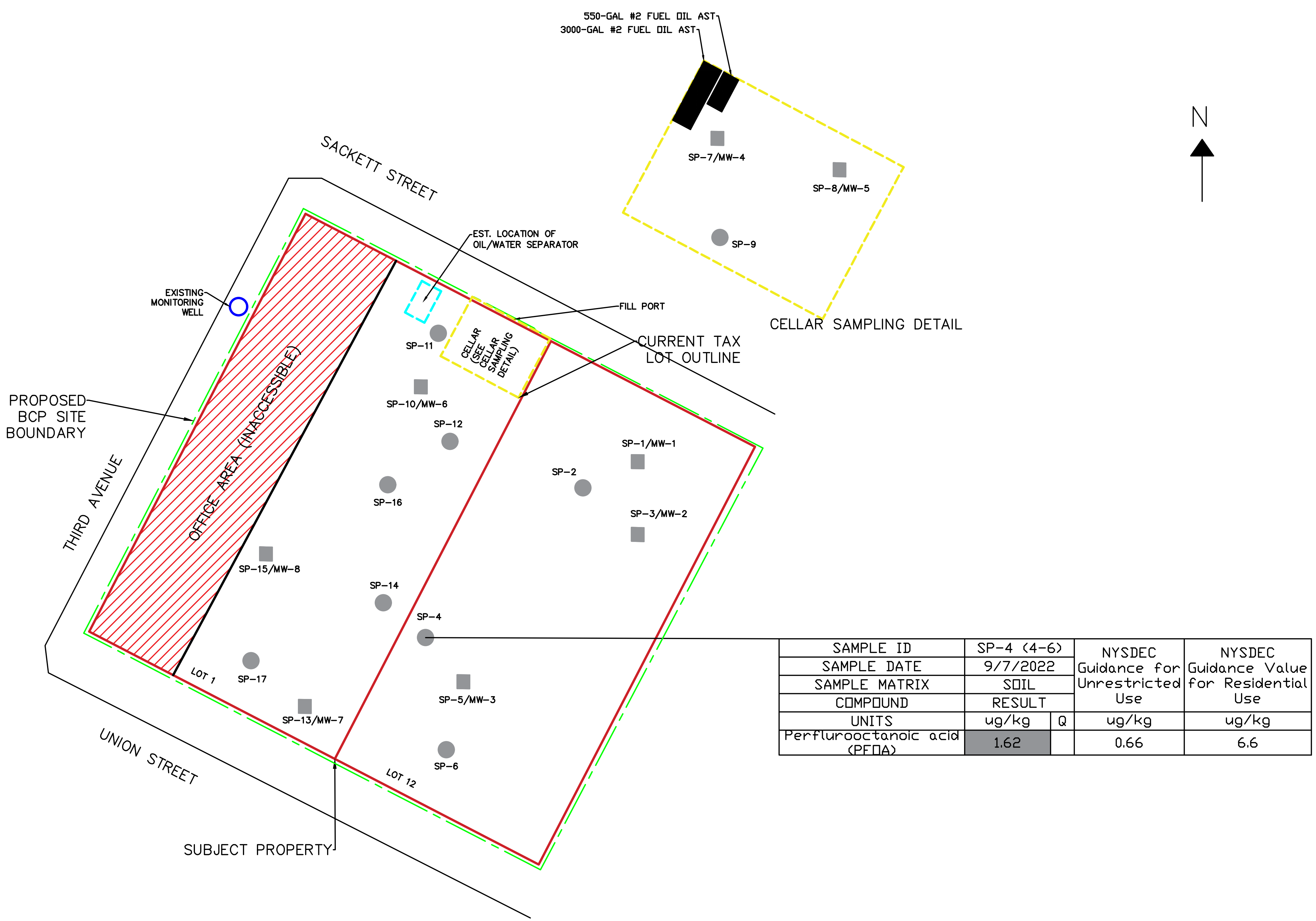
PROJECT NAME AND ADDRESS

601–607 UNION STREET,
BROOKLYN

PROJECT FIGURE

FIGURE 3: VOCs, SVOCs, METALS IN SOIL

PROJECT NO. 220073	DATE 7/5/2023
DRAWN BY G.T.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.



SAMPLE ID	SP-4 (4-6)		NYSDEC Guidance for Unrestricted Use	NYSDEC Guidance Value for Residential Use
SAMPLE DATE	9/7/2022			
SAMPLE MATRIX	SOIL			
COMPOUND	RESULT			
UNITS	ug/kg	Q	ug/kg	ug/kg
Perflurooctanoic acid (PFOA)	1.62		0.66	6.6

LEGEND:

●	LOCATION OF HISTORIC SOIL PROBES (SP-)
■	LOCATION OF HISTORIC SOIL PROBES/TEMPORARY MONITORING WELLS (SP-/MW-)
○	LOCATION OF EXISTING MONITORING WELL INSTALLED BY OTHERS
▬	SAMPLE EXCEEDS NYSDEC GUIDANCE VALUE FOR UNRESTRICTED USE

NOTE:
1. CELLAR SHAPE IS ESTIMATED AND NOT TO SCALE
2. ALL SAMPLES WERE ANALYZED FOR 1,4-DIOXANE AND PFAs. ONLY THE COMPOUND(S) EXCEEDING RESPECTIVE GUIDANCE VALUE(S) ARE MAPPED ON THIS PLAN.

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

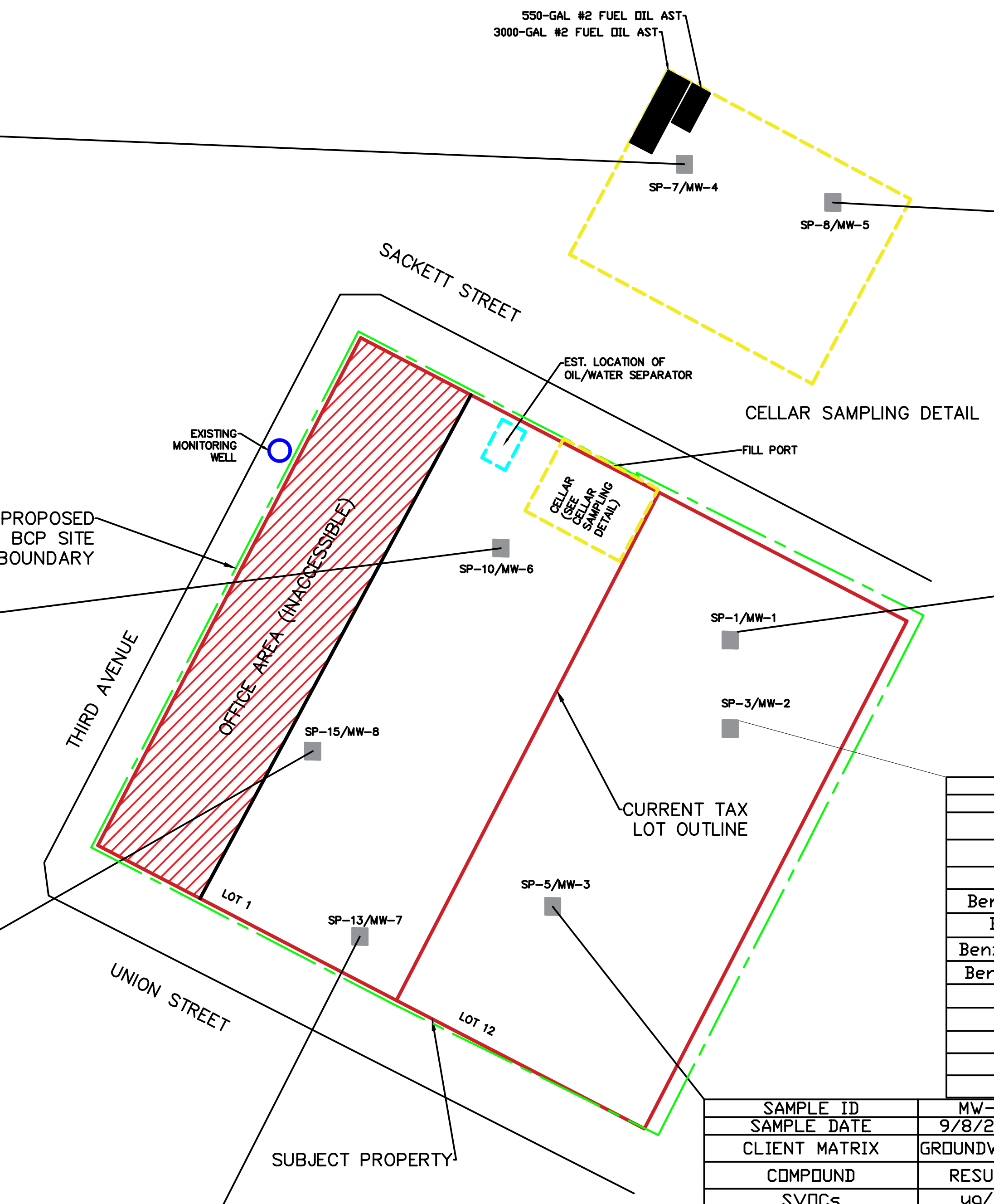
TEL: (631) 462-5866

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS
601-607 UNION STREET,
BROOKLYN

PROJECT FIGURE
FIGURE 4: PFAs IN SOIL

PROJECT NO. 220073	DATE 7/5/2023
DRAWN BY G.T.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.



SAMPLE ID	MW-4	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
SVOCs	ug/L	ug/L
Benzo(a)anthracene	0.36	0.002
Benzo(a)pyrene	0.19	0.002
Benzo(b)fluoranthene	0.16	0.002
Benzo(k)fluorathene	0.17	0.002
Chrysene	0.37	0.002
Indeno(1,2,3-cd)pyrene	0.10	0.002
TOTAL SVOCs	12.10	NS
DISSOLVED METALS		
Manganese	539	300
Sodium	47500	20000
Beryllium	18.5	3

SAMPLE ID	MW-5	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
DISSOLVED METALS		
Barium	3170	1000
Chromium	339	50
Lead	9230	25
Magnesium	47800	35000
Manganese	5070	300
Nickel	1990	100
Sodium	166000	20000
Zinc	11700	2000
Beryllium	13.2	3

SAMPLE ID	MW-6	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
DISSOLVED METALS		
Lead	653	25
Magnesium	89600	35000
Manganese	910	300
Sodium	258000	20000
Beryllium	136	3

SAMPLE ID	MW-1	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/8/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
DISSOLVED METALS		
Manganese	461	300
Sodium	46500	20000
Antimony	7.29	3

SAMPLE ID	MW-2	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/8/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
SVOCs	ug/L	ug/L
Benzo(a)anthracene	0.17	0.002
Benzo(a)pyrene	0.11	0.002
Benzo(b)fluoranthene	0.13	0.002
Benzo(k)fluorathene	0.15	0.002
Chrysene	0.18	0.002
TOTAL SVOCs	4.23	NS
DISSOLVED METALS		
Manganese	578	300
Antimony	11.3	3

SAMPLE ID	MW-8	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
SVOCs	ug/L	ug/L
Benzo(a)anthracene	0.090	0.002
Chrysene	0.080	0.002
Indeno(1,2,3-cd)pyrene	0.050	0.002
TOTAL SVOCs	5.52	NS
DISSOLVED METALS		
Barium	2930	1000
Chromium	97.9	50
Lead	8410	25
Magnesium	146000	35000
Manganese	2640	300
Nickel	119	100
Sodium	246000	20000
Zinc	3440	2000
Beryllium	47.0	3

SAMPLE ID	MW-3	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/8/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
SVOCs	ug/L	ug/L
Benzo(a)anthracene	0.074	0.002
Benzo(a)pyrene	0.063	0.002
Benzo(b)fluoranthene	0.053	0.002
Benzo(k)fluorathene	0.063	0.002
Chrysene	0.074	0.002
TOTAL SVOCs	2.34	NS
DISSOLVED METALS		
Lead	60.1	25
Magnesium	58200	35000
Manganese	720	300
Sodium	64300	20000
Antimony	8.08	3

SAMPLE ID	MW-7	NYSDEC TOGS Standards and Guidance Values - GA
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
VOCs	ug/L	ug/L
Benzene	6.21	1
TOTAL VOCs	22.76	NS
SVOCs	ug/L	ug/L
Benzo(a)pyrene	0.10	0.002
TOTAL SVOCs	0.94	NS
DISSOLVED METALS		
Barium	2230	1000
Lead	172	25
Magnesium	83400	35000
Manganese	12100	300
Nickel	148	100
Zinc	2560	2000
Beryllium	11.3	3

LEGEND:

■	LOCATION OF HISTORIC SOIL PROBES/TEMPORARY MONITORING WELLS (SP-/MW-)
○	LOCATION OF EXISTING MONITORING WELL INSTALLED BY OTHERS
▬	SAMPLE EXCEEDS NYSDEC TOGS STANDARDS AND GUIDANCE VALUES - GA

NOTE:

1. CELLAR SHAPE IS ESTIMATED AND NOT TO SCALE

2. ALL SAMPLES WERE ANALYZED FOR VOCs, SVOCs, METALS (TOTAL AND DISSOLVED), PCBs AND PESTICIDES. ONLY THE COMPOUND(S) EXCEEDING RESPECTIVE REGULATORY STANDARD(S) ARE MAPPED ON THIS PLAN.

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

TEL: (631) 462-5866

BASE DRAWING PREPARED BY

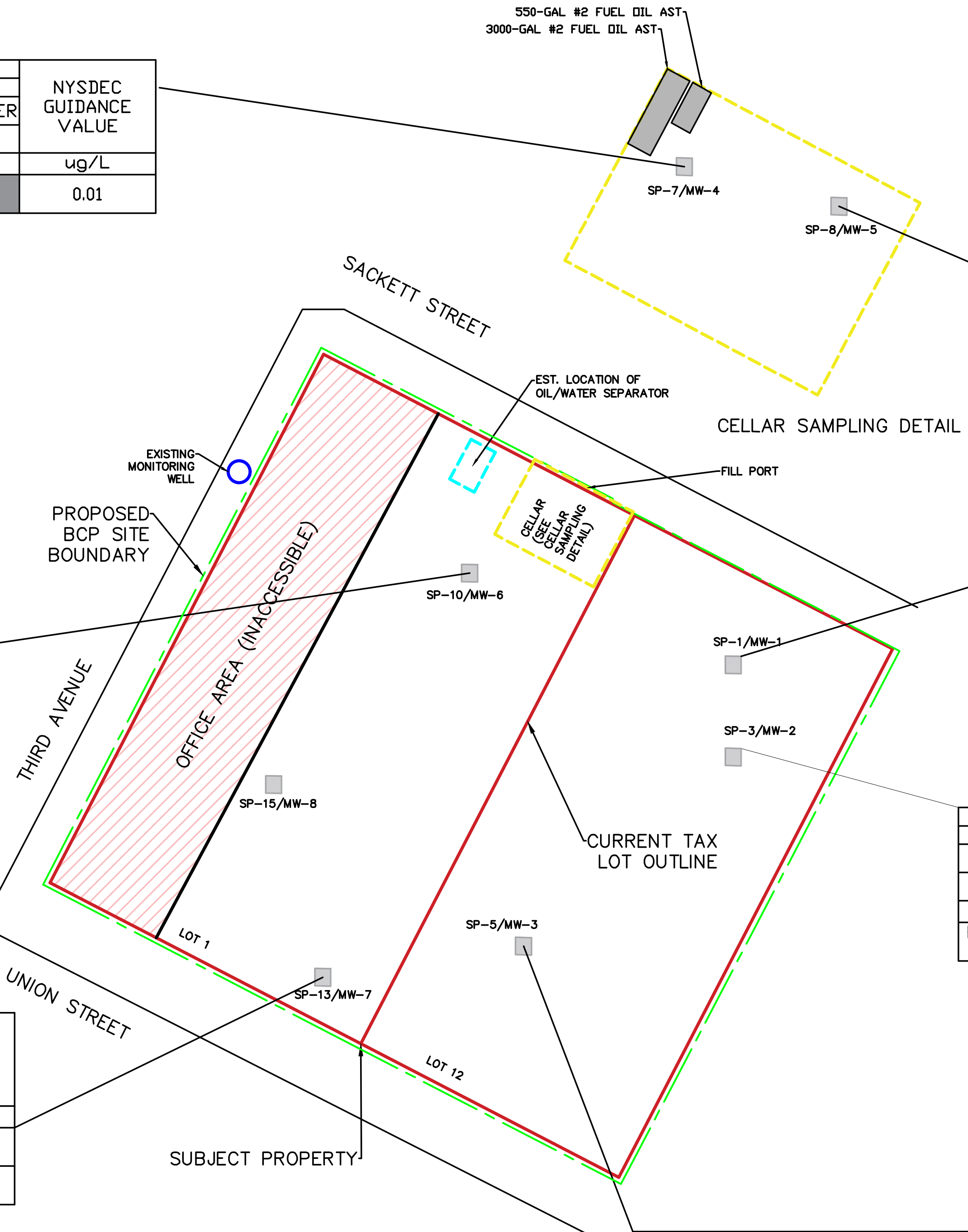
PROJECT NAME AND ADDRESS

601-607 UNION STREET,
BROOKLYN

PROJECT FIGURE

FIGURE 5: VOCs, SVOCs, METALS IN GROUNDWATER

PROJECT NO. 220073	DATE 7/5/2023
DRAWN BY G.T.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.



SAMPLE ID	MW-4	NYSDEC GUIDANCE VALUE
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
UNITS	ug/L	ug/L
Perfluorooctanoic acid (PFOA)	0.051	0.01

SAMPLE ID	MW-5	NYSDEC GUIDANCE VALUE
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
UNITS	ug/L	ug/L
Perfluorooctanesulfonic acid (PFOS)	0.014	0.01
Perfluorooctanoic acid (PFOA)	0.051	0.01

SAMPLE ID	MW-6	NYSDEC GUIDANCE VALUE
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
UNITS	ug/L	ug/L
1,4-Dioxane	1.54	1
UNITS	ug/L	ug/L
Perfluorooctanoic acid (PFOA)	0.021	0.01

SAMPLE ID	MW-1	NYSDEC GUIDANCE VALUE
SAMPLE DATE	9/8/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
UNITS	ug/L	ug/L
Perfluorooctanoic acid (PFOA)	0.070	0.01

SAMPLE ID	MW-2	NYSDEC GUIDANCE VALUE
SAMPLE DATE	9/8/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
UNITS	ug/L	ug/L
Perfluorooctanoic acid (PFOA)	0.011	0.01

SAMPLE ID	MW-7	NYSDEC GUIDANCE VALUE
SAMPLE DATE	9/9/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
UNITS	ug/L	ug/L
Perfluorooctanesulfonic acid (PFOS)	0.042	0.01
Perfluorooctanoic acid (PFOA)	0.055	0.01

SAMPLE ID	MW-3	NYSDEC GUIDANCE VALUE
SAMPLE DATE	9/8/2022	
CLIENT MATRIX	GROUNDWATER	
COMPOUND	RESULT	
UNITS	ug/L	ug/L
Perfluorooctanoic acid (PFOA)	0.043	0.01

LEGEND:

- ◻ LOCATION OF SOIL PROBES/TEMPORARY MONITORING WELLS (SP-/MW-)
- ○ LOCATION OF EXISTING MONITORING WELL INSTALLED BY OTHERS
- ▬ SAMPLE EXCEEDS NYSDEC GUIDANCE VALUE

NOTE:

1. CELLAR SHAPE IS ESTIMATED AND NOT TO SCALE
2. ALL SAMPLES WERE ANALYZED FOR 1,4-DIOXANE AND PFAs. ONLY THE COMPOUND(S) EXCEEDING RESPECTIVE GUIDANCE VALUE(S) ARE MAPPED ON THIS PLAN.

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

TEL: (631) 462-5866

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS
601-607 UNION STREET,
BROOKLYN

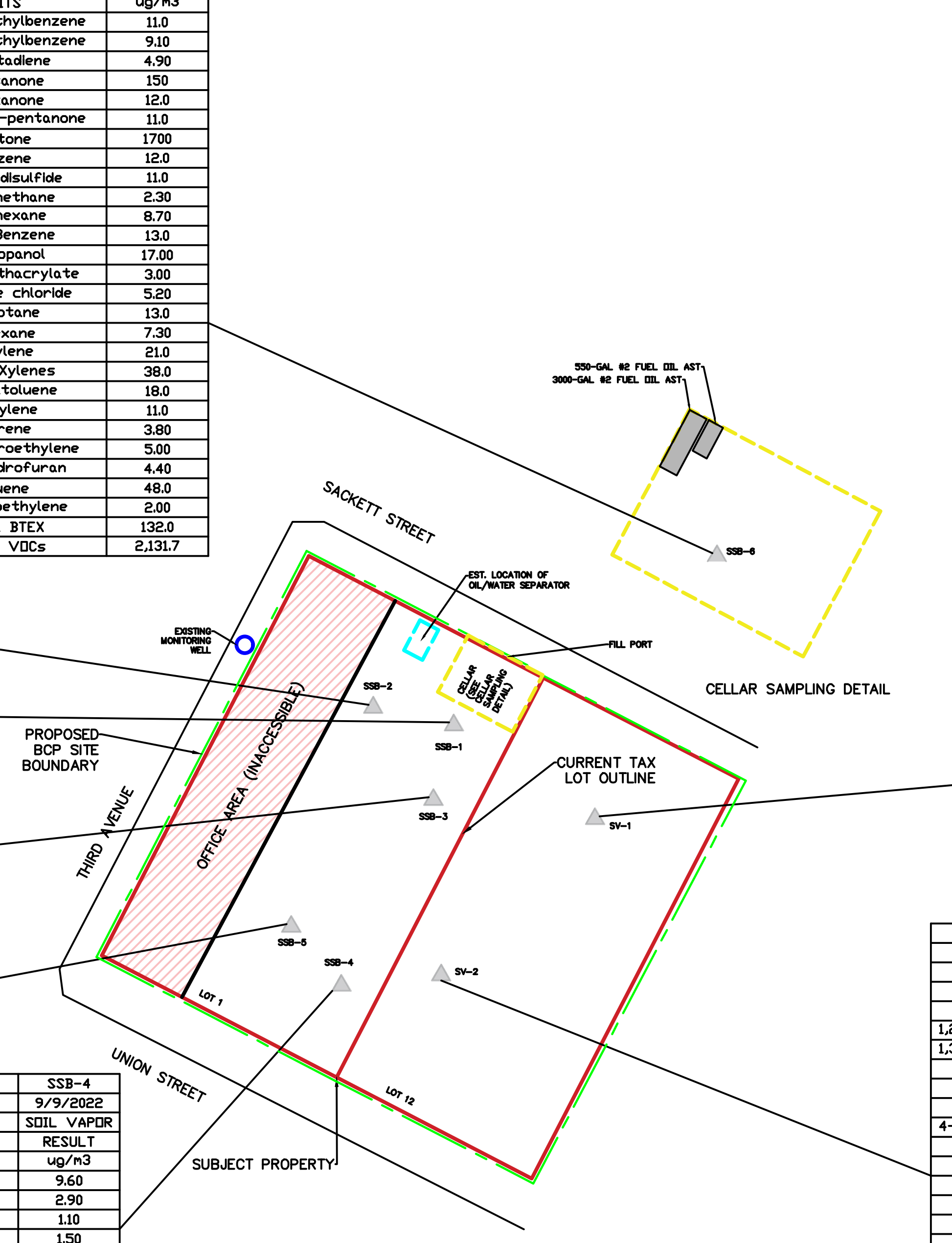
PROJECT FIGURE
FIGURE 6: 1,4-DIOXANE AND PFAs IN GROUNDWATER

PROJECT NO. 220073	DATE 7/5/2023
DRAWN BY G.T.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.

SAMPLE ID	SSB-1
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,1-Dichloroethane	0.68
1,2,4-Trimethylbenzene	24.0
1,3,5-Trimethylbenzene	7.90
1,3-Butadiene	1.10
1,4-Dioxane	1.20
2-Butanone	3.90
2-Hexanone	4.50
4-Methyl-2-pentanone	1.40
Acetone	51.0
Benzene	2.20
Carbon disulfide	0.68
Chloroethane	0.44
Chloroform	1.80
Chloromethane	1.40
cis-1,2-Dichloroethylene	7.20
Cyclohexane	5.40
Dichlorodifluoromethane	2.10
Ethyl acetate	1.20
Ethyl Benzene	8.60
Isopropanol	18.00
Methyl Methacrylate	0.82
Methylene chloride	1.80
n-Heptane	8.60
n-Hexane	6.00
o-Xylene	14.0
p-&m- Xylenes	30.0
p-Ethyltoluene	26.0
Propylene	9.40
Tetrachloroethylene	92.0
Tetrahydrofuran	2.10
Toluene	13.0
trans-1,2-Dichloroethylene	2.20
Trichloroethylene	21.0
Trichlorofluoromethane (Freon 11)	1.20
Vinyl Chloride	0.60
TOTAL BTEX	67.8
TOTAL VOCs	373.4

SAMPLE ID	SSB-2
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,2,4-Trimethylbenzene	5.80
1,3,5-Trimethylbenzene	1.40
1,3-Butadiene	1.30
2-Butanone	0.89
2-Hexanone	1.70
Acetone	6.20
Benzene	1.70
Chloroform	4.20
Chloromethane	0.46
cis-1,2-Dichloroethylene	0.40
Cyclohexane	1.70
Dichlorodifluoromethane	2.10
Ethyl acetate	1.50
Ethyl Benzene	1.80
Isopropanol	1.80
Methyl Methacrylate	0.83
Methylene chloride	1.40
n-Heptane	1.20
n-Hexane	1.10
o-Xylene	2.50
p-&m- Xylenes	7.30
p-Ethyltoluene	5.10
Propylene	2.40
Styrene	0.86
Tetrachloroethylene	550
Toluene	4.60
Trichloroethylene	240
Trichlorofluoromethane (Freon 11)	1.20
TOTAL BTEX	17.9
TOTAL VOCs	851.4

SAMPLE ID	SSB-6
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,2,4-Trimethylbenzene	11.0
1,3,5-Trimethylbenzene	9.10
1,3-Butadiene	4.90
2-Butanone	150
2-Hexanone	12.0
4-Methyl-2-pentanone	11.0
Acetone	1700
Benzene	12.0
Carbon disulfide	11.0
Chloromethane	2.30
Cyclohexane	8.70
Ethyl Benzene	13.0
Isopropanol	17.00
Methyl Methacrylate	3.00
Methylene chloride	5.20
n-Heptane	13.0
n-Hexane	7.30
o-Xylene	21.0
p-&m- Xylenes	38.0
p-Ethyltoluene	18.0
Propylene	11.0
Styrene	3.80
Tetrachloroethylene	5.00
Tetrahydrofuran	4.40
Toluene	48.0
Trichloroethylene	2.00
TOTAL BTEX	132.0
TOTAL VOCs	2,131.7



SAMPLE ID	SV-1
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,2,4-Trimethylbenzene	1.40
1,3-Butadiene	1.30
2-Butanone	23.0
2-Hexanone	5.70
Acetone	99.0
Acrylonitrile	0.54
Benzene	1.70
Carbon disulfide	23.0
Chloromethane	0.87
Cyclohexane	8.50
Dichlorodifluoromethane	1.30
Ethyl acetate	1.40
Ethyl Benzene	2.10
Isopropanol	3.70
Methylene chloride	1.30
n-Heptane	6.60
n-Hexane	19.0
o-Xylene	1.90
p-&m- Xylenes	4.20
p-Ethyltoluene	0.94
Propylene	67.0
Tetrachloroethylene	1.30
Toluene	3.10
Trichloroethylene	0.51
TOTAL BTEX	13.0
TOTAL VOCs	279.4

SAMPLE ID	SSB-3
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,2,4-Trimethylbenzene	33.0
1,3,5-Trimethylbenzene	11.0
1,3-Butadiene	1.20
1,4-Dioxane	1.30
2-Butanone	7.80
2-Hexanone	5.70
4-Methyl-2-pentanone	5.70
Acetone	77.0
Acrylonitrile	0.38
Benzene	9.10
Bromomethane	0.68
Carbon disulfide	3.80
Chloromethane	1.30
Cyclohexane	28.0
Dichlorodifluoromethane	1.90
Ethyl acetate	2.40
Ethyl Benzene	20.0
Isopropanol	10.00
Methyl Methacrylate	4.30
Methyl tert-butyl ether (MTBE)	0.76
Methylene chloride	1.30
n-Heptane	38.0
n-Hexane	27.0
o-Xylene	26.0
p-&m- Xylenes	60.0
p-Ethyltoluene	40.0
Propylene	53.0
Tetrachloroethylene	150.0
Tetrahydrofuran	9.20
Toluene	37.0
Trichloroethylene	2.60
Trichlorofluoromethane (Freon 11)	1.10
TOTAL BTEX	152.1
TOTAL VOCs	672.0

SAMPLE ID	SSB-5
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,1-Dichloroethane	3.901
1,2,4-Trimethylbenzene	12.0
1,3,5-Trimethylbenzene	5.30
1,4-Dioxane	1.70
2-Butanone	19.0
4-Methyl-2-pentanone	2.20
Acetone	110
Acrylonitrile	2.90
Benzene	2.80
Carbon disulfide	28.0
Chloromethane	0.88
Cyclohexane	49.0
Dichlorodifluoromethane	1.90
Ethyl acetate	3.80
Ethyl Benzene	7.30
Isopropanol	5.10
Mehyl tert-butyl ether (MTBE)	40.0
Methylene chloride	1.60
n-Heptane	35.0
n-Hexane	74.0
o-Xylene	9.40
p-&m- Xylenes	22.0
p-Ethyltoluene	13.0
Propylene	93.0
Styrene	1.20
Tetrachloroethylene	5.30
Tetrahydrofuran	13.0
Toluene	7.50
Trichloroethylene	2.50
TOTAL BTEX	29.0
TOTAL VOCs	575.3

SAMPLE ID	SSB-4
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,2,4-Trimethylbenzene	9.60
1,3,5-Trimethylbenzene	2.90
1,3-Butadiene	1.10
2-Butanone	1.50
2-Hexanone	1.40
4-Methyl-2-pentanone	0.68
Acetone	14.0
Benzene	1.40
Carbon disulfide	1.60
Carbon tetrachloride	0.31
Chloromethane	1.40
Cyclohexane	0.91
Dichlorodifluoromethane	2.00
Ethyl Benzene	3.50
Isopropanol	1.80
Methylene chloride	1.20
n-Heptane	1.90
n-Hexane	1.20
o-Xylene	5.50
p-&m- Xylenes	16.0
p-Ethyltoluene	9.60
Propylene	4.10
Styrene	0.71
Tetrachloroethylene	17.0
Tetrahydrofuran	0.98
Toluene	5.30
Trichloroethylene	0.71
Trichlorofluoromethane (Freon 11)	1.20
Vinyl Chloride	0.21
TOTAL BTEX	31.7
TOTAL VOCs	109.7

SAMPLE ID	SV-2
SAMPLE DATE	9/9/2022
CLIENT MATRIX	SOIL VAPOR
COMPOUND	RESULT
UNITS	ug/m3
1,2,4-Trimethylbenzene	2.50
1,3,5-Trimethylbenzene	0.85
1,3-Butadiene	1.10
2-Butanone	7.00
2-Hexanone	2.60
4-Methyl-2-pentanone	1.10
Acetone	53.0
Acrylonitrile	0.83
Benzene	3.00
Carbon disulfide	0.75
Cyclohexane	2.10
Ethyl acetate	1.60
Ethyl Benzene	1.10
Isopropanol	3.10
Methylene chloride	1.30
n-Heptane	28.0
n-Hexane	35.0
o-Xylene	1.60
p-&m- Xylenes	3.50
p-Ethyltoluene	1.40
Propylene	57.0
Styrene	0.74
Tetrachloroethylene	4.80
Toluene	5.90
Trichloroethylene	0.47
TOTAL BTEX	15.1
TOTAL VOCs	220.3

LEGEND:

- ▲ LOCATION OF SOIL VAPOR PROBES (SV-) OR SUB-SLAB VAPOR PROBES (SSB-)
- ○ LOCATION OF EXISTING MONITORING WELL INSTALLED BY OTHERS
- 🟨 VALUE MAY REQUIRE NO FURTHER ACTION OR TRIGGER MONITORING OR MITIGATION AS PER NYSDOH DECISION MATRICES
- 🟪 VALUE TRIGGERS MITIGATION AS PER NYSDOH DECISION MATRICES

NOTE:
1. CELLAR SHAPE IS ESTIMATED AND NOT TO SCALE

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HydroTech

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

TEL: (631) 462-5866

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS

601-607 UNION STREET,
BROOKLYN

PROJECT FIGURE

FIGURE 7: VOCs IN SOIL VAPOR AND SUB-SLAB VAPOR

PROJECT NO. 220073	DATE 7/3/2023
DRAWN BY G.T.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.

LEGEND:

- ● LOCATION OF HISTORIC SOIL PROBES (SP–)
- ■ LOCATION OF HISTORIC SOIL PROBES/TEMPORARY MONITORING WELLS (SP–/MW–)
- ▲ LOCATION OF HISTORIC SOIL VAPOR PROBES (SV–) OR SUB–SLAB VAPOR PROBES (SSB–)
- ○ LOCATION OF EXISTING MONITORING WELL INSTALLED BY OTHERS
- ● LOCATION OF SOIL PROBES (SP–)
- ■ LOCATION OF SOIL PROBES/TEMPORARY MONITORING WELSS (SP=/MW–)
- ▲ LOCATION OF SUB–SLAB VAPOR PROBES (SSB–)

NOTE:
CELLAR SHAPE IS ESTIMATED
AND NOT TO SCALE

DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET,
SUITE 1104, NEW YORK,
NY 10001

TEL: (631) 462–5866

BASE DRAWING PREPARED BY

PROJECT NAME AND ADDRESS

601–607 UNION STREET,
BROOKLYN

PROJECT FIGURE

FIGURE 8: PROPOSED SAMPLING PLAN

PROJECT NO. 220073	DATE 7/6/2023
DRAWN BY G.T.	REVIEWED BY R.X.
SCALE (11X17) AS SHOWN	APPROVED BY T.K.

APPENDICES

APPENDIX A: HASP

HEALTH & SAFETY PLAN

601-607 Union Street
Brooklyn, New York
Block 434, Lots 1 and 12

Table of Contents

Figures

Attachments

1.0 Introduction

The HASP has been prepared in conformance with applicable regulations, safe work practices and the project's requirements. It addresses those activities associated with the installation and sampling of soil probes, monitoring wells and soil vapor/sub-slab vapor sampling points and collection of ambient outdoor air samples. The Project Manager (PM), Site Safety Officer (SSO) and HydroTech field staff will implement the Plan during site work. Compliance with this HASP is required of all persons and third parties who perform fieldwork for this project. Assistance in implementing this HASP can be obtained from the HydroTech's SSO. The content of this HASP may change or undergo revision based upon additional information that is made available to health and safety personnel, monitoring results or changes in the technical scope of work. Any changes proposed must be reviewed by the SSO.

SCOPE OF WORK

The Scope of Work activities will include the following:

- Installation of soil probes, temporary monitoring wells and sub-slab vapor sampling points
- Characterization and collection of soil, vapor& groundwater samples

EMERGENCY NUMBERS

Contact	Phone Number
New York – Presbyterian Brooklyn Methodist Hospital	718-960-9000
New York City EMS	911
NYPD	911
NYFD	911
National Response Center	800-424-8802
Poison Information Center	800-562-8816
Chemtree	800-424-9555

PROJECT MANAGEMENT/HEALTH AND SAFETY PERSONNEL

Title	Contact	Phone Number	Cell Phone
Geologist	Ruijie Xu	718-636-0800	631-229-7090
Site Safety Officer	Ruijie Xu	718-636-0800	631-229-7090
Project Manager	Ruijie Xu	718-636-0800	631-229-7090

DIRECTIONS TO INTERFAITH MEDICAL CENTER

Head east on Union Street towards 6th Avenue. Turn right onto 6th Avenue and then turn left onto 5th Street. Turn right onto 7th Avenue and the hospital will be on the left side. **Figure 1** include the map showing the direction to the closest hospital with emergency room(s).

2.0 Health and Safety Staff

This section briefly describes the personnel and their health and safety responsibilities for the:

PROJECT GEOLOGIST– Ruijie Xu

- Has the overall responsibility for the health and safety of site personnel
- Ensures that adequate resources are provided to the field health and safety staff to carry out their responsibilities as outlined below.
- Ensures that fieldwork is scheduled with adequate personnel and equipment resources to complete the job safely.
- Ensures that adequate telephone communication between field crews and emergency response personnel is maintained.
- Ensures that field site personnel are adequately trained and qualified to work at the Site.

SITE SAFETY OFFICER – Ruijie Xu

- Directs and coordinates health and safety monitoring activities.
- Ensures that field teams utilize proper personal protective equipment (PPE).
- Conducts initial onsite, specific training prior to personnel and/or subcontractors proceeding to work.
- Conducts and documents periodic safety briefings; ensures that field team members comply with this HASP.
- Completes and maintains Accident/Incident Report Forms.
- Notifies HydroTech corporate administration of all accidents/incidents.
- Determines upgrade or downgrade of PPE based on site conditions and/or downgrade of PPE based on site conditions and/or real-time monitoring results.
- Ensures that monitoring instruments are calibrated daily or as determined by manufactured suggested instructions.
- Maintains health and safety field log books.
- Develops and ensures implementation of the HASP.
- Approves revised or new safety protocols for field operations.
- Coordinates revisions of this HASP with field personnel and the SSO Division Contracting Officer.
- Responsible for the development of new company safety protocols and procedures and resolution of any outstanding safety issues which may arise during the conduction of site work.
- Reviews personnel and subcontractors current and up-to-date medical examination and acceptability of health and safety training.

FIELD PERSONNEL AND SUBCONTRACTORS (IF ANY)

- Reports any unsafe or potentially hazardous conditions to the SSO.
- Maintains knowledge of the information, instructions and emergency response actions contained in this HASP.
- Comply with rules, regulations and procedures as set forth in this HASP and any revisions that are instituted.
- Prevents admittance to work sites by unauthorized personnel.

3.0 Chemical & Waste Description/Characterization

The following suspect chemicals are likely to be identified during the soil and groundwater sampling at the Site:

- Volatile Organic Compounds
- Semi Volatile Organic Compounds
- Metals
- Polychlorinated Biphenyls (PCBs)
- Pesticides

Attachment A contains information regarding assessing health risks from chemicals of concern, which are suspected to be identified at the Site.

The following information references are presented in order to identify the properties and hazards of the materials that may/will be encountered at the Site.

- Dangerous Properties of Industrial Materials - Sax
- Chemical Hazards of the Workplace - Proctor/Hughes
- Condensed Chemical Dictionary – Hawley
- Rapid Guide to Hazardous Chemical in the Workplace - Lewis 1990.
- NIOSH Guide to Chemical Hazards - 1990
- ACGIH TLV Values and Biological Exposure Indices - 1991-1992

4.0 Hazard Assessment

The potential hazards associated with planned site activities include chemical, physical and biological hazards. This section discusses those hazards that are anticipated to be encountered during the activities listed in the scope of work.

The potential to encounter chemical hazards is dependent upon the work activity performed (invasive or non-invasive), the duration and location of the work activity. Such hazards could include inhalation or skin contact with chemicals that could cause: dermatitis, skin burn, being overcome by vapors or asphyxiation. In addition, the handling of contaminated materials and chemicals could result in fire and/or explosion.

The potential to encounter physical hazards during site work includes: heat stress, exposure to excessive noise, loss of limbs, being crushed, head injuries, cuts and bruises and other physical hazards due to motor vehicle operation, heavy equipment and power tools.

CHEMICAL HAZARDS

The potential for personnel and subcontractors to come in contact with chemical hazards may occur during the following tasks:

- Installation of soil probes, monitoring well and sub-slab vapor sampling points

Exposure Pathways
Exposure to these compounds during ongoing activities may occur through inhalation of contaminated dust particles, inhalation of volatile (VOC) and semi-volatile (SVOC) vapor fume compounds, by way of dermal absorption, and accidental ingestion of the contaminant by either direct or indirect cross contamination activities (eating, smoking, poor hygiene). Indirectly, inhalation of contaminated dust particles (metals, silica, VOCs, SVOCs) can occur during adverse weather conditions (high or changing wind directions) or during operations that may generate airborne dust such as excavation, and sampling activities. Dust control measures such as applying water to roadways and work sites will be implemented, where visible dust is generated from non-contaminated and contaminated soils. Where dust control measures are not feasible or effective, respiratory protection will be used.

Additional Precautions
Dermal absorption or skin contact with chemical compounds is possible during

invasive activities at the Site, including removal of product, excavation of tanks, and handling of contaminated soils. The use of PPE in accordance with Section 9.2 and strict adherence to proper decontamination procedures should significantly reduce the risk of skin contact.

The potential for accidental ingestion of potentially hazardous chemicals is expected to be remote, when good hygiene practices are used.

PHYSICAL HAZARDS

A variety of physical hazards may be present during Site activities. These hazards are similar to those associated with any construction type project. These physical hazards are due to motor vehicles, and heavy equipment operation, the use of improper use of power and hand tools, misuse of pressurized cylinders, walking on objects, tripping over objects, working on surfaces which have the potential to promote falling, mishandling and improper storage of solid and hazardous materials, skin burns, crushing of fingers, toes, limbs, hit on the head by falling objects or hit one's head due to not seeing the object of concern, temporary loss of one's hearing and/or eyesight. Theses hazards are not unique and are generally familiarly to most hazardous waste site workers at construction sites. Additional task specific safety requirements will be covered during safety briefings.

Noise

Noise is a potential hazard associated with operation of heavy equipment, power tools, pumps and generators. High noise operators will be evaluated at the discretion of the SSO. Employees with an 8-hour time weighted average exposure exceeding 85 decibels (db) will be included in the hearing conservation program in accordance with 29 CFR 1910.85.

It is mandated that employees working around heavy equipment or using power tools that dispense noise levels exceeding 95 db are to wear hearing protection that shall consist of earplugs and earphones. This is particularly relevant as the jet engines of modern airplanes can give sound level readings of greater than 110 db.

Heat/Cold Stress

Extremes in temperature and the effects of hard work in impervious clothing can result in heat stress and/or hypothermia. The human body is designed to function at a certain internal temperature. When metabolism or external sources (fire, hot summer day, winter weather, etc.) cause the body temperature to rise or fall excessively, the body seeks to protect itself by triggering cooling/warming mechanisms. Profuse sweating is an example of a cooling mechanism, while uncontrollable shivering is an example of a warming mechanism. The SSO monitor the temperature to determine potential adverse effects the weather can cause on site personnel.

Protective clothing worn to guard against chemical contact effectively stops the evaporation of perspiration. Thus the use of protective clothing increases heat stress problems. Cold stress can easily occur in winter with sub-freezing ambient temperatures. Workers in protective garments may heat-up and sweat, only to rapidly cool once out of the tank and the PPE. The major disorders due to heat stress are heat cramps, heat exhaustion and heat stroke.

HEAT CRAMPS are painful spasms that occur in the skeletal muscles of workers who sweat profusely in the heat and drink large quantities of water, but fail to replace the body's lost salts or electrolytes. Drinking water while continuing to lose salt tends to dilute the body's extra cellular fluids. Soon water seeps by osmosis into active muscles and causes pain. Muscles fatigued from work as usually most susceptible to cramps.

HEAT EXHAUSTION is characterized by extreme weakness or fatigue, dizziness, nausea, and headache. In serious cases, a person may vomit or lose consciousness. The skin is clammy and moist, complexion pale or flushed, and body temperature normal or slightly higher than normal. Treatment is rest in a cool place and replacement of body water lost by perspiration. Mild cases may recover spontaneously with this treatment; severe cases may require care for several days. There are no permanent effects.

HEAT STROKE is a very serious condition caused by the breakdown of the body's heat regulating mechanisms. The skin is very dry and hot with red mottled or bluish appearance. Unconsciousness, mental confusion or convulsions may occur. Without quick and adequate treatment, the result can be death or permanent brain damage. Get medical assistance quickly! As first aid treatment, the person should be moved to a cool place. Soaking the person's clothes with water and fanning them should reduce body heat artificially, but not too rapidly.
Steps that can be taken to reduce heat stress are:

- Acclimatize the body. Allow a period of adjustment to make further heat exposure endurable.
- Drink more liquids to replace body water lost during sweating.
- Rest is necessary and should be conducted under the monitoring condition

from the SSO and the effect personnel physiological state.

- Wearing personal cooling devices. There are two basic designs; units with pockets for holding frozen packets and units that circulate a cooling fluid from a reservoir through tubes to different parts of the body. Both designs can be in the form of a vest, jacket or coverall. Some circulating units also have a copy for cooling the head.

Cold temperatures can cause problems. The severe effects are FROSTBITE and HYPOTHERMIA.

FROSTBITE is the most common injury resulting from exposure to cold. The extremities of the body are often affected. The signs of frostbite are:

- The skin turns white or grayish-yellow
- Pain is sometimes felt early but subsides later. Often there is no pain
- The affected part feels intensely cold and numb

Shivering, numbness, drowsiness, muscular weakness and a low internal body temperature characterize the condition known as HYPOTHERMIA. This can lead to unconsciousness and death. With both frostbite and hypothermia, the affected areas need to be warmed quickly. Immersing in warm, not hot, water best does this. In such cases medical assistance will be sought.

To prevent these effects from occurring, persons working in the cold should wear adequate clothing and reduce the time spent in the cold area. The field SSO, to determine appropriate time personnel may spend in adverse weather conditions, will monitor this.

Lockout/Tagout

PURPOSE -- This program establishes procedures for de-energizing, isolating and ensuring the energy isolation of equipment and machinery. The program will be used to ensure that equipment and machinery is de-energizing and isolated from unexpected energization by physically locking (Lockout) energy isolation devices or, in the absence of locking capabilities, tagout (Tagout) the device to warn against energization. These procedures will provide the means of achieving the purpose of this program, prevention of injury to HydroTech employees from the unexpected energization or start-up of equipment and machinery, or from the release of stored energy.

APPLICATION -- This program applies to the control of energy during the servicing and/or maintenance of equipment and machinery. This program covers normal operations only if a guard or other safety device is removed or bypassed, or any part of the body is placed into an area of the equipment or machinery where work is performed on the material, or a danger zone exists during the operating cycle. Minor tool changes, adjustments, and other minor servicing activities which take place during normal production operations do not require isolation and lockout/tagout if they are routine and integral to the use of the equipment.

SCOPE -- This program will include all employees whose duties require them to service, install, repair, adjust, lubricate, inspect or perform work on powered equipment or machinery that may also have the potential for stored energy.

PROGRAM RESPONSIBILITIES -- The SSO will have the overall responsibility of the program to ensure that; authorized and affected employees receive adequate training and information, the program is evaluated annually, and the lockout/tagout equipment is properly used and the procedures of this program are followed.

The program evaluation will be conducted to ensure that the procedures and requirements of the program are being followed and will be utilized to correct any deviations or inadequacies that may be discovered. The evaluation will consist of one or more inspections or audits of actual lockout/tagout procedures being used to isolate equipment. A review of the authorized and affected employee's responsibilities will be conducted at the time of the inspection /audit. Any authorized employee, except the one(s) utilizing the energy isolation procedure being inspected, may perform the inspection/audit.
A record will be maintained of program evaluation inspections and will include:

1. The identity of the equipment or machine on which energy control procedures were being utilized.
2. The date(s) of the inspection(s).
3. The employee(s) included in the inspection(s).
4. The person performing the inspection.

Authorized employees (persons who implement lockout/tagout procedures) will be responsible for following the procedures established by this program.

Affected employees are responsible for understanding the significance of a lockout/tagout device and the prohibition relating to attempts to restart or re-energize equipment or machinery that is locked out or tagged out.

TRAINING – Where applicable, HydroTech employees will be provided instruction in the purpose and functions of the energy control program to ensure that they understand the significance of locked or tagged out equipment and also have the knowledge and skill to correctly apply and remove energy controls. Training will include:

The recognition of applicable hazardous energy source(s), the type and magnitude of energy available, and the policies and procedures of the HydroTech energy control program.

1. Affected employees will be made aware of the purpose and use of energy control procedures and the prohibition relating to attempts to remove lockout or tagout devices.
2. Instruction in the limitations of tagout as a sole means of energy control.
    a. Tags are warning devices and <u>do not</u> provide the physical restraint that a lock would do.
    b. Tags may provide a false sense of security.
    c. Tags may become detached during use.

Initial training will be provided during to energy control program implementation, when new employees are hired or when job responsibilities change to include utilization of energy control procedures.

Retraining will be conducted whenever there is a change in job assignments that require the employee to utilize energy control procedures, a change in equipment that presents a new hazard, a change in the energy control procedures or when the program evaluation identifies inadequacies in the energy control program procedures.

Records of employee training will be maintained and will include the employee's name and date(s) of training.

STANDARD OPERATING PROCEDURES –where necessary, HydroTech will provide the necessary devices to effectively lockout or tagout energy isolating devices. Lockout/tagout devices will be the only devices used for controlling energy and shall not be used for other purposes. Any device used for lockout/tagout will be capable of withstanding the environment to which they are exposed for the maximum period they are to be exposed. The devices will be substantial enough to prevent removal without excessive force. Excessive force for a locking device would be bolt cutters or other metal cuttings tools. Tagout devices will be attached by a non-reusable method, attachable by hand, and very difficult to remove by hand. A nylon cable tie or equivalent will be used.

Lockout/tagout devices will indicate the identity of the employee who applied the device, and the tagout device will warn against the hazards if the equipment is energized.

Lockout is the preferred method of energy isolation. When physical lockout is not possible, the energy isolation will be tagged out of service with a warning tag attached at the power source. In the case of plug-in power source, the tag will be attached at the male plug. To ensure full employee protection using tagout instead of lockout, additional steps should be taken to guard against accidental or inadvertent energization. These steps may include, where applicable: removal of fuses, blocking switches, removal of a valve handle.

STANDARD OPERATING PROCEDURES

I. APPLICATION OF CONTROLS

A. Preparing to Shut Down Equipment

1. Prior to equipment shutdown, the authorized employee(s) must have knowledge of:
    a. The type(s) and magnitude of power.
    b. The hazards of the energy to be controlled.
    c. The method(s) to control the energy.
    d. The location and identity of all isolating devices that control or feed the equipment to be locked/tagged out.
2. Notify all affected employees that the lockout/tagout system will be in effect.
3. Assemble applicable lockout/tagout devices, i.e., padlocks, tags, multiple lock hasps, etc.

B. Equipment Shutdown and Isolation

1. If equipment is in operation, shut it down by the normal stopping procedure (stop button, switch).
2. Operate disconnects, switches, valves, or other energy isolating devices so that the equipment is de-energizing and isolated from its energy source(s).
3. Verify that equipment is shut down by operating equipment from the normal operating location and any remote locations.

C. Installation of Lockout/Tagout Device, Release of Stored Energy, and Verification

1. Attach individually assigned lock(s) or tag(s) to energy isolating device(s). Where it is not possible to lock a switch, valve or other isolating device, electrical fuses must be removed, blank flanges installed in piping, lines disconnected, or other suitable methods used to ensure that equipment is isolated from energy sources. A tag must be installed at the point of power interruption to warn against energizing.

2. Each lock or tag must positively identify the person who applied it and locks must be individually keyed.
3. If more than one person is involved in the task, employees will place their own lock and tag. Multiple lock hasps are available for this.
4. Release, restrain, or dissipate stored energy such spring tension, elevated machine members, rotating flywheels, hydraulic pressure, pistons and air, gas, steam, water pressure, etc. by repositioning, blocking bleeding, or other suitable means.
5. Prior to starting work on equipment and after ensuring that no personnel are exposed, the authorized employee will verify that isolation and de-energization have been accomplished by:
    a. Attempting, through normal effort, to operate energy isolating devices such as switches, valves, or circuit breaker with locks or tags installed.
    b. Attempting to operate the equipment or machinery that is locked or tagged out. This includes all sources of energy, i.e. electrical, hydraulic, gravity, air, water, stream pressure, etc.
6. Verifying the presence and effectiveness of restraint (blocking) and energy dissipation or release (bleeding).
7. If there is a possibility of the re-accumulation of stored energy to a hazardous level, verification of isolation will be contained until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

D. Group Lockout/Tagout

1. When more than one individual is involved in locking or tagging equipment out of operation, each individual will attach their individual lock or tag, or the equivalent, to the energy isolating device(s).
    a. An equivalent lockout device may be in the form of a group lockout device such as a multiple lock hasp or lock box.
    b. Primary responsibility for a group of authorized employees working under a group lockout device will be vested in a designated authorized employee.
    c. Group lockout methods will provide a level of protection equal to that afforded by a personal lockout/tagout device.

II. RETURNING EQUIPMENT TO SERVICE

A. Restore Equipment to Normal Operating Status

1. Re-install all parts or subassemblies removed for servicing or maintenance.
2. Re-install all tools, rests, or other operating devices
3. Re-install all guards and protective devices (i.e. limit switches).

4. Remove all blocks, wedges, or other restraints from the operating area of the equipment (ways, slides, etc.).
5. Remove all tools, equipment, and shop towels from the operating area of the equipment.

B. Verify Equipment Ready for Operation

1. Inspect area for non-essential items
2. Ensure that all employees are safely positioned clear of the operating areas of the equipment. Post a watch if energy isolation devices are not in line of sight of the equipment.

C. Notify Affected Employees of Impending Start-up

1. The sudden noise of start-up may startle nearby employees.
2. Equipment may need to be tested to determine operational safety by a qualified operator.

D. Remove Energy Isolation Devices - Only by authorized employee(s) who installed it/them.

1. Remove line blanks, reconnect piping (if applicable), and remove warning tag.
2. Close bleeder valves, remove warning tag.
3. Replace fuse(s), close circuit breaker(s) and remove warning tag.
4. Remove lock and tag from control panel, valve, etc.

Employee(s) who installed them may make an exception for removal of lockout/tagout devices. If it is necessary to operate a piece of equipment that is locked/tagged out, <u>every</u> effort must be made to locate the employee whose lock or tag is on the equipment. If he or she cannot be located and only after positive assurance is made that no one is working on the locked out equipment, the <u>supervisor</u> may personally remove the lock. The supervisor must assure that the equipment is once again locked out, or the employee notified that the equipment has been re-energized, before the employee resumes work. Employees will recheck locked out equipment if they have left the equipment (breaks, lunch, and end of shift) to make sure it is still de-energized and locked out.

III. TEMPORARY REMOVAL OF LOCKOUT/TAGOUT PROTECTION

A. In situations when the equipment must be temporarily energized to test or position the equipment or its components, the following steps will be followed:

1. Clear the equipment of tools and materials that are non-essential to the operation.
2. Ensure the equipment components are operationally intact.
3. Remove employees from the equipment area.
4. Remove the lockout/tagout devices by the employee who installed in/them.
5. Energize and proceed with testing or positioning.

6. De-energize all systems and re-install all energy control measures.
7. Verify re-installed energy control measures are effective.

IV. SHIFT OR PERSONNEL CHANGES

A. The following steps will be followed to ensure continuity of employee protection during personnel changes.

1. All personnel involved in the maintenance or servicing activity will be notified that a transfer of personal locks/tags is about to occur.
2. Clear all personnel from hazardous area(s) of equipment.
3. Under the supervision of the shift supervisor or group designee, the off-going employee will immediately install theirs.
    a. If an entire group or more than one employee will be transferring work responsibility, locks/tags will be removed and replaced one at a time in order of installation.
4. When the transfer of lockout/tagout devices is complete, the effectiveness of all energy isolation devices will be verified to the satisfaction of all personnel involved.
5. Once the effectiveness of energy isolation protection is confirmed, the service/maintenance operation may continue.

V. CONTRACTOR NOTIFICATION

A. Whenever outside personnel may be engaged in activities covered by this program, they will inform the contractor of applicable lockout/tagout procedures used to protect HydroTech employees from the hazards of working near energized equipment.

1. The contractor will be expected to ensure that his/her employees understand and comply with the restrictions and prohibitions of this program.
2. HydroTech requires, under these circumstances, the contractor to inform us of their lockout/tagout procedures so that HTE employees can comply with the restrictions and prohibitions of the contractor’s program.
3. HydroTech also requires the contractor to notify the program administrator, the area supervisor, and affected HydroTech employees prior to de-energizing, isolating and locking out HydroTech equipment. Conversely, notification is also required when this equipment will be returned to service.

DEFINITIONS

Affected employee - An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee(s) - A person or persons who locks or implements a tagout system procedure to perform servicing or maintenance on a machine or equipment. An authorized employee and an affected employee may be the same person when the affected employee’s duties also include performing maintenance or service on a machine or equipment that must be locked or tagged out.

“Capable of being locked out” - An energy isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or if it has a locking mechanism built into it. Other energy isolating devices will also be considered to be capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability.

Energized - Connected to an energy source or containing residual or stored energy.

Energy isolating device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and, in addition, no pole can be operated independently; a slide gate; a slip blind; a line valve; a block; and any similar device used to block or isolate energy. The term does not include a push button, selector switch, and other control circuit type devices.

Energy source - any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other type of energy.

Lockout - The placement of lockout device on an energy-isolating device, in accordance with an established procedure, is ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device - A device that utilizes positive means such as a lock, either key or combination type, to hold an energy isolating device in the safety position and prevent the energizing of a machine or equipment.

Normal production operations - The utilization of a machine or equipment to perform its intended production function.

Servicing and/or maintenance - Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Setting up - Any work performed to prepare a machine or equipment to perform its normal production operation.

Stored energy - Energy that is available and may cause movement even after energy sources have been isolated. Stored energy may be in the form of compressed springs, elevated equipment components, hydraulic oil pressure, pressurized water, air, steam, or gas, or rotating flywheels, shafts or cams.

Tagout - The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device - A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

GENERAL MACHINERY AND EQUIPMENT LIST

EQUIPMENT/LOCATION	ENERGY SOURCES/LOCATION
Geoprobe	Gasoline Engine

5.0 Training

GENERAL HEALTH AND SAFETY TRAINING

In accordance with HydroTech corporate policy, and pursuant to 29 CFR 1910.120, hazardous waste site workers shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations. As a minimum, the training shall have consisted of instruction in the topics outlined in the above reference. Personnel who have not met the requirements for initial training will not be allowed to work in any site activities in which they may be exposed to hazards (chemical or physical).

Completion of the HydroTech Health and Safety Training Course for Hazardous Waste Operations or an approved equivalent will fulfill the requirements of this section. In addition to the required initial training, each employee shall have received 3 days of directly supervised on-the-job training. This training will address the duties the employees are expected to perform.
The HydroTech SSO the responsibility of ensuring that personnel assigned to this project complies with these requirements. Written certification of completion of the required training will be provided to the SSO.

MANAGER/SUPERVISOR TRAINING

In accordance with 29 CFR 1910.120, onsite management and supervisors who will be directly responsible for, or who supervise employees engaged in hazardous waste operation shall receive training as required in this HASP and at least eight (8) additional hours of specialized training on managing such operations at the time of job assignment.

ANNUAL 8-HOUR REFRESHER TRAINING

Annual 8-hour refresher training will be required of all hazardous waste site field personnel in order to maintain their qualification for fieldwork. The following topics will be reviewed: toxicology, respiratory protection, including air purifying devices and self-contained breathing apparatus (SCBA), medical surveillance, decontamination procedures and personnel protective clothing. In addition, topics deemed necessary by the SSO may be added to the above list.

SITE SPECIFIC TRAINING

Prior to commencement of field activities, all personnel assigned to the project will be provided training that will specifically address the activities, procedures, monitoring and equipment for the site operations. It will include Site and facility layout, hazards, and emergency services at the Site, and will highlight all provisions contained within this HASP. This training will also allow field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and operations for their particular activity.

ONSITE SAFETY BRIEFINGS

Project personnel and visitors will be given periodic onsite health and safety briefings by the SSO, or their designee, to assist site personnel in safely conducting their work activities. The briefings will include information on new operations to be conducted, changes in work practices or changes in the Site's environmental conditions. The briefings will also provide a forum to facilitate conformance with safety requirements and to identify performance deficiencies related to safety during daily activities or as a result of safety audits.

ADDITIONAL TRAINING

Additional training may be required by the SSO for participation in certain field tasks during the course of the project. Such additional training could be in the safe operation of heavy or power tool equipment or hazard communication training.

SUBCONTRACTOR TRAINING

Subcontractor personnel who work onsite, only occasionally, for a specific limited task and who are unlikely to be exposed over permissible exposure limits, may be exempted from the initial 40-hour training requirement. The SSO will determine if this exemption is allowed. In any case, the subcontractor personnel who are exposed to hazards are not exempted from the 40-hours training requirement nor medical surveillance requirements found in Section 8.1.

6.0 Medical Surveillance

GENERAL

All contractor and subcontractor personnel performing field work at the Site are required to have passed a complete medical surveillance examination in accordance with 29 CFR 1910.120 (f). A physician's medical release for work will be confirmed by the SSO before an employee can begin site activities. Such examinations shall include a statement as to the worker's present health status, the ability to work in a hazardous environment (including any required PPE which may be used during temperature extremes), and the worker's ability to wear respiratory protection.

A medical data sheet will be completed by all onsite personnel and kept at the Site. Where possible, this medical data sheet will accompany the personnel needing medical assistance or transport to hospital facilities.

MEDICAL SURVEILLANCE PROTOCOL

The medical surveillance protocol to be implemented is the occupational physicians' responsibility, but shall meet the requirements of CFR 1910.120 and ANSI Z88.2 (1980). The medical surveillance protocol shall, as a minimum, cover the following:

a. Medical and Occupational History
b. General physical examination (including evaluation of major organ system)
c. Serum lead and ZPP
d. Chest X-ray (performed no more frequently that every four years, except when otherwise indicated).
e. Pulmonary Function Testing (FVC and FEV1.0).
f. Ability to wear respirator
g. Audiometric testing.

Additional clinical tests may be included at the discretion of the occupational physician.

7.0 Site Control, PPE & Communications

SITE CONTROL

A Support Zone (SZ) is an uncontaminated area that will be the field support area for most operations. The SZ provides for field team communications and staging for emergency response. Appropriate sanitary facilities and safety equipment will be located in this zone. Potentially contaminated personnel or materials are not allowed in this zone. The only exception will be appropriately packaged/decontaminated and labeled samples. A contamination reduction corridor will be established. This is the route of entry and egress to the Site, and it provides an area for decontamination of personnel and portable equipment as well.

The area where contamination exists is considered to be the Exclusion Zone (EZ). All areas where excavation and handling of contaminated materials take place are considered the EZ. This zone will be clearly delineated by cones, tape or other means. The SSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy
- Appropriate personal protective equipment
- Medical authorization
- Training certification

PERSONAL PROTECTIVE EQUIPMENT

GENERAL

The level of protection worn by field personnel will be enforced by the SSO. Levels of protection for general operations are provided below and are defined in this section. Levels of protection may be upgraded or downgraded at the discretion of the SSO. The decision shall be based on real-time air monitoring, site history data, and prior site experience. Any changes in the level of protection shall be recorded in the health and safety field logbook.

PERSONAL PROTECTIVE EQUIPMENT SPECIFICATIONS

For tasks requiring Level B PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Chemical protective suit (e.g. Saran-coated Tyvek®)
- Gloves, inner (latex)

- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot Covers (as needed)
- Hard Hat
- Hearing protection (as needed)

For tasks requiring Level C PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Disposable outer coveralls (Poly-coated Tyvek)
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC), steel toe/shank
- Boot covers (as needed)
- Hard Hat
- Hearing protection (as needed)
- Splash suit and face shield for decontamination operations (as needed)

For tasks requiring Level D PPE, the following equipment shall be used:

- Cotton or disposable coveralls
- Gloves, inner (latex)
- Gloves, outer (Nitrile®)
- Boots (PVC) steel toe/shank
- Boot covers (as needed)
- Hard hat
- Hearing protection (as needed)
- Safety glasses

For tasks requiring respiratory protection, the following equipment shall be used:

Level D - No respiratory protective equipment necessary except for a dust mask
Level C - A full-face air-purifying respirator equipped with organic
vapor/pesticide-HEPA cartridges
Level B - An air line respirator or a self-contained breathing apparatus (SCBA)

INITIAL LEVELS OF PROTECTION

Levels of protection for the activities may be upgraded or downgraded depending on direct-reading instruments or personnel monitoring. The following are the initial levels of protection that shall be used for each planned field activity.

LEVEL OF PERSONAL PROTECTIVE EQUIPMENT REQUIRED

Activity	**Level of Protection Respiratory/PPE**
Drilling/Coring	C/D
Sampling	C/D
Ground-Penetrating Radar/Magnetometer	C/D

COMMUNICATIONS

Communications is the ability to talk with others. While working in Level C/B Protection, personnel may find that communication becomes a more difficult task and process to accomplish. This is further complicated by distance and space. In order to address this problem, electronic instruments, mechanical devices or hand signals will be used as follows:

- Walkie-Talkies - Hand held radios would be utilized as much as possible by field teams for communication between downrange operations and the Command Post base station.

- Telephones - A mobile telephone will be located in the Command Post vehicle in the Support Zone for communication with emergency support services/facilities. If a telephone is demobilized, the nearest public phones will be identified.

- Air Horns - A member of the downrange field team will carry an air horn and another will be evident in the Support Zone to alert field personnel to an emergency situation.

- Hand Signals - Members of the field team long with use of the buddy system will employ this communication method. Signals become especially important when in the vicinity of heavy moving equipment and when using Level B respiratory equipment. The signals shall become familiar to the entire field team before site operations commence and they will be reinforced and reviewed during site-specific training.

HAND SIGNALS FOR ONSITE COMMUNICATION

Signal	**Meaning**
Hand gripping throat	Out of air, can’t breathe
Grip partners’ wrist	Leave area immediately; no debate

Hands on top of head	Need assistance
Thumbs up	OK, I'm all right; I understand
Thumbs down	No; negative, unable to understand you. I'm not all right

8.0 Air Monitoring Plan

GENERAL

Continuous air monitoring in the EZ during invasive tasks will accompany site operations, as indicated in this HASP or as required by the SSO. Monitoring will be performed to verify the adequacy of respiratory protection, to aid in site layout and to document work exposure. All monitoring instruments shall be operated by qualified personnel only and will be calibrated daily prior to use, or more often as necessary.

REAL-TIME MONITORING

INSTRUMENTATION

At least one (1) of the following monitoring instruments will be available for use during field operations as necessary:

- Photoionization Detector (PID), Rae Instruments with 10.2 EV probe or equivalent

- Flame Ionization Detector (FID), Foxboro Model 128 or equivalent

- Combustible Gas Indicator (CGI)/Oxygen (O_2) Meter, MSA or equivalent.

A FID or PID shall be used to monitor the organic vapor concentrations in active work areas. Organic vapor concentrations shall be measured upwind of the work areas to determine background concentrations. The SSO will interpret monitoring results using professional judgment. The PPE utilized shall always be the most protective, thus the action level criteria are flexible guidelines.

A CGI/O_2 meter shall be used to monitor for combustible gases and oxygen content in the boreholes during drilling activities.

Calibration records shall be documented, and included in the health and safety logbook or instrument calibration logbook. All instruments shall be calibrated before and after each daily use in accordance with the manufacturers' procedures.

ACTION LEVELS

Action levels for upgrading of PPE in this HASP will apply to all site work during the duration of field activities at the Site. Action levels are for unknown contaminants using direct reading in the Breathing Zone (BZ) for organic vapors and dusts, and at the source for combustible gases.

MONITORING DURING FIELD ACTIVITIES

HydroTech shall perform real time air monitoring prior to the commencement of work to establish baseline conditions. Baseline conditions will be established at the approximate center of the Site and at the perimeter of the Site both upwind and downwind.

During all work activities real time monitoring will occur. As necessary, HydroTech shall have at each applicable workstation a PID, explosimeter and oxygen deficiency meter. The real time monitoring for remedial activities will be conducted approximating the Breathing Zone of the workers. The monitoring will be continuous during working operations.

The air-monitoring instrument may indicate that personnel working in the exclusion zone increase their level of protection. All personnel will be trained in the action levels. When conditions warrant an increase in protection, all personnel will stop working and immediately leave the exclusion zone. They will then don the appropriate safety equipment necessary and return to their current workstation. All of this activity will be monitored by the SSO. The SSO will keep the HydroTech Project Manager aware of any extraordinary situations and conditions that may occur. Working conditions and monitoring levels will be noted in the Field Notebook along with the time, date and page number. Verbal reports will be given to the Project Manager when there is a change in the PPE level.

The previous day's results shall be reviewed each morning to determine what actions are necessary and the general conditions resulting from and around the Site.

The record keeping will include:

- Date & Time of Monitoring
- Air Monitoring Location
- Instrument, Model #, Serial #
- Calibration/Background Levels
- Results of Monitoring
- SSO Signature
- Comments

Excavation Operations - Monitoring will be performed continuously during all excavation and demolition operations. A PID and/or FID shall be utilized to monitor the breathing zone, the excavated area and any material taken from the excavation. A CGI/O_2 meter shall be used to monitor the excavation for the presence of combustible gases.

ACTION LEVELS OF AIRBORNE CONTAMINANTS

INSTRUMENT	**ACTION LEVEL**	**ACTION TO BE TAKEN**
FID/PID	< 100 ppm, for a 15-minute average	Stop work & initiate vapor control
	>100 ppm, for a 15-minute average	Stop work & initiate evacuation procedure
CGI	10% LEL	Stop work, initiate ventilating
	50% LEL	Stop work, initiate evacuation procedure and contact fire dept.

PERSONNEL MONITORING PROCEDURE

The Site SSO, concurrent with activities that may generate the contaminants in excess of OSHA PEL's, may perform assessment and evaluation of field personnel exposures to airborne contaminants.

Procedures to be followed include:

The SSO may select high-risk individuals who may be subject to contaminant exposure based on job assignment.
The Personal Sampling is being conducted to determine the proper levels of respiratory protection required, to document potential exposures to compounds, and to assure compliance with OSHA standards. Therefore, it is important that the data collected be from "worst case" locations and personnel.

For example: when work is being conducted to excavate at an underground tank location, those persons closest to the excavation and most intimately involved with the work should be sampled. If a backhoe operator solely conducted the excavation, then that employee should be monitored. However, if there are additional workers who must enter the excavation and work with the freshly excavated soil, these persons would be closer to the potential contaminants and they should be sampled.

To meet the intent of the sampling will require sampling at periods of the most disturbances. To be accurate in determining potential exposures, as many tasks/trades shall be sampled as possible during the course of this project. At completion of the project, a goal of 20% of all workers who must perform their duties in or around the contaminated soil, tanks and excavations is sought.

All sampling data must be provided in writing to the employees within three (3) days of receipt of results by HydroTech.

Air sampling pumps used to collect employee exposure samples shall be calibrated before and after use each day. Calibration shall be accomplished using a primary standard calibration system, e.g. the bubble tube method. Results of the calibrations shall be included in the health and safety field logbook and with the exposure report.

Chemical analysis of samples collected for assessment of employee exposures shall be performed in accordance with NIOSH or OSHA analytical methods only by laboratories accredited by the American Industrial Hygiene Association.

Results of the personal exposure assessment shall be provided to the individual, in writing within fifteen (15) working days after receipt of laboratory reports. Reports to field personnel shall provide calculated time-weighted average exposures and shall provide comparative information relative to established permissible exposure limits. The air sampling data sheet and laboratory report is considered a part of the employee exposure report. A copy of the employee personal exposure assessment report shall also be included in the project file and the employees' medical record for HydroTech employees. Reports for subcontractor employees will be sent directly to the subcontractors' employer.

AIR MONITORING REPORTS

Air Monitoring Reports will be completed by the SSO and/or authorized personnel and submitted to the Project Manager in the daily safety logs and will include the following:

- Date of monitoring
- Equipment utilized for air monitoring
- Real-time air monitoring results from each work location
- Calibration method of equipment and results

9.0 Safety Considerations

GENERAL

In addition to the specific requirements of this HASP, common sense should be used at all times. The general safety rules and practices below will be in effect at the Site at the discretion of the Project Manager, SSO or other authorized personnel.

- The site will be suitably marked or barricaded as necessary to prevent unauthorized visitors but not hinder emergency services if needed.

- As needed, all open holes, trenches and obstacles will be properly barricaded in accordance with local site requirements. These requirements will be determined by proximity to traffic ways, both pedestrian and vehicular, and site of the hole, trench or obstacle. If holes are required to be left open during non-working hours, they will be adequately decked over or barricaded and sufficiently lighted.

- Before any digging or boring operations are conducted, underground utility locations will be identified. All boring, excavation and other site work will be planned and performed with consideration for underground lines. Any excavation work will be performed in accordance with HydroTech's Standard Operating Procedures for Excavations.

- Either workers or other people will enact dust-mitigating procedures when there exists the potential for the inhalation of dust particles.

- The act of smoking and ignition sources in the vicinity of potentially flammable or contaminated material is strictly prohibited.

- Drilling, boring, and use of cranes and drilling rigs, erection of towers, movement of vehicles and equipment and other activities will be planned and performed with consideration for the location, height, and relative position of aboveground utilities and fixtures, including signs; canopies; building and other structures and construction; and natural features such as trees, boulders, bodies of water, and terrain.

- When working in areas where flammable vapors may be present, particular care shall be exercised with tools and equipment that may be sources of ignition. All tools and equipment provided must be properly bonded and/or grounded. Metal buttons and zippers are prohibited on safety clothing for areas that may contain a flammable or explosive atmosphere.

- Approved and appropriate safety equipment (as specified in this HASP), such as eye protection, hard hats, foot protection, and respirators, must be worn in areas where required. In addition, eye protection must be worn when sampling soil or water that may be contaminated.

- Beards interfere with respirator fit and are not allowed within the site boundaries because all site personnel may be called upon to use respirator protection is some situations.

- No smoking, eating, chewing tobacco, gum chewing or drinking will be allowed in the contaminated areas.

- Contaminated tools and hands must be kept away from the face.

- Personnel must use personal hygiene safe guards (washing up) at the end of the shift or as soon as possible after leaving the Site.

- Each sample must be treated and handled as though it were contaminated.

- Persons with long hair and/or loose fitting clothing that could become entangled in power equipment must take adequate precautions.

- Horseplay is prohibited in the work area.

- Work while under the influence of intoxicants, narcotics or controlled substances is prohibited.

POSTED SIGNS

Posted danger signs will be used where an immediate hazard exists. Caution signs will be posted to warn against potential hazards and to caution against unsafe practices. Traffic control methods and barricades will be used as needed. Wooden stakes and flagging tape, or equally effective material will be used to demarcate all restricted areas.

Other postings may include the OSHA poster, emergency hospital route and telephone numbers of contact personnel.

INVASIVE OPERATIONS

The SSO will be present onsite during all invasive work (e.g. demolition, excavations). The SSO will ensure that appropriate levels of protection and safety procedures are followed. No personnel will enter any excavations for any reasons. All personnel will stay at least 10 feet back from the edge of the excavation and out of the swing radius of the backhoe. No drums or other potential sources will be sampled or removed during this phase without further additions to the HASP.

The proximity of water, sewer and electrical lines will be identified prior to invasive operations. The possibility of the presence of underground conduits or vessels containing materials under pressure will also be investigated prior to invasive operations. Properly-sized containment systems will be utilized and consideration of the potential volume of liquid or waste released during operations will be discussed with members of the field team to minimize the potential for spills and provide a method for collection of waste materials. Emergency evacuation procedures and the location of safety equipment will be established prior to start up operations. The use of protective clothing, especially hard hats, boots, and gloves will be required during drilling and other heavy equipment work.

SOIL AND GROUNDWATER SAMPLING

Personnel must wear prescribed protective clothing and equipment including eye protection, chemical resistant gloves and splash aprons (where appropriate) when sampling solids and liquids. Sample bottles are to be bagged prior to sampling to ease decontamination. Personnel must be aware of the location of emergency equipment, including spill containment materials prior to sampling. Personnel are to practice contamination avoidance at all times, as well as to utilize the buddy system and maintain communications with the Command Post.

SAMPLE HANDLING

Personnel responsible for the handling of samples will wear the prescribed level of protection. Samples are to be identified as to their hazard and packaged as to prevent spillage or breakage. Any unusual sample conditions shall be noted. Laboratory personnel and all field personnel shall be advised of sample hazard levels and the potential contaminants present. This can be accomplished by a phone call to the lab coordinator and/or including a written statement with the samples reviewing lab safety procedures in handling in order to assure that the practices are appropriate for the suspected contaminants in the sample.

HEAVY EQUIPMENT DECONTAMINATION

Personnel steam cleaning heavy equipment shall use the prescribed level of protection and adhere to the buddy system. Initially this task usually employs level C. The heavy equipment decontamination shall be restricted to authorized personnel only. Special consideration will be given to wind speed and direction. Downwind areas are to be kept free of personnel to avoid unnecessary exposure to potential airborne contamination.

ADDITIONAL SAFETY CONSIDERATIONS

No other additional safety considerations at this time.

10.0 Decontamination and Disposal Procedures

CONTAMINATION PREVENTION

One of the most important aspects of decontamination is the prevention of contamination. Good contamination prevention should minimize worker exposure and help ensure valid sample results by precluding cross-contamination. Procedures for contamination avoidance include:

Personnel:
Do not walk through areas of obvious or known contamination
Do not directly handle or touch contaminated materials
Make sure that there are no cuts or tears on PPE
Fasten all closures in suits; cover with tape if necessary
Particular care should be taken to prevent any skin injuries
Stay upwind of airborne contaminants
Do not carry cigarettes, cosmetics, gum, etc. into contaminated areas

Sampling and Monitoring:
When required by the SSO, cover instruments with clear plastic, leaving openings for sampling ports and bag sample containers prior to emplacement of sample material.

Heavy Equipment:
Care should be taken to limit the amount of contamination that comes in contact with heavy equipment (tires, contaminated augers). Dust control measures may be needed on roads inside the site boundaries.

PERSONNEL DECONTAMINATION

All personnel shall pass through an outlined decontamination procedure when exiting the hot zone at each location. Field washes for equipment and PPE shall be set up at each drilling location. The system will include a gross wash and rinse for all disposable clothing and boots worn in the EZ. Upon exiting the EZ, all personnel will wash their hands, arms, neck, and face before entering the Support Zone.

EQUIPMENT DECONTAMINATION

Equipment used at the Site that is potentially contaminated shall be decontaminated to prevent hazardous materials from leaving the Site. All heavy equipment will be decontaminated at the decontamination pad and inspected by the SSO and Project Manager before it leaves the Site. The decontamination area will provide for the containment of all wastewater from the decontamination process. Respirators, airline and any other personnel equipment that comes in contact with contaminated soils shall pass through a field wash.

DECONTAMINATION DURING MEDICAL EMERGENCIES

If emergency life-saving first aid and/or medical treatment are required, normal decontamination procedures may need to be abbreviated or omitted. The Site SSO or designee will accompany contaminated victims to the medical facility to advice on matters involving decontamination, when necessary. The outer garments can be removed if they do not cause delays, interfere with treatment or aggravate the problem. Respiratory equipment must always be removed. Protective clothing can be cut away. If the outer contaminated garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances and /or medical personnel. Outer garments are then removed at the medical facility.

No attempt will be made to wash or rinse the victim, unless it is known that the individual has been contaminated with an extremely toxic or corrosive material that could also cause severe injury or loss of life to emergency response personnel. For minor medical problems or injuries, the normal decontamination procedures will be followed. Note that heat stroke requires prompt treatment to prevent irreversible damage or death. Protective clothing must be promptly removed. Less serious forms of heat stress also require prompt attention and removal of protective clothing immediately; unless the victim is obviously contaminated, decontamination should be omitted or minimized and treatment begun immediately.

DISPOSAL PROCEDURES

A segregating system of non-hazardous waste and hazardous waste will be developed by the SSO and PM. All discarded material, waste materials or other objects shall be handled in such a way as to preclude the potential for spreading contamination, creating sanitary hazards, or causing litter to be left on site. All potentially contaminated materials, e.g. clothing, gloves, etc., will be bagged or drummed as necessary, labeled and segregated for disposal. All non-contaminated materials shall be collected and bagged for appropriate disposal as normal domestic waste.

11.0 Emergency Plan

The potential for the development of an emergency situation is low considering the low concentrations of hazardous substances at the work site. Nevertheless, an emergency situation could occur. All HydroTech and subcontractor field team members prior to the start of work will know the emergency plan outlined in this section. The emergency plan will be available for use at all times during site work.

Various individual site characteristics will determine preliminary actions taken to assure that this emergency plan is successfully implemented in the event of a site emergency. Careful consideration must be given to the proximity of neighborhood housing or places of employment, and to the relative possibility of site fire, explosion or release of vapors or gases that could affect the surrounding community.

The Project Manager shall make contact with local fire, police and other emergency units prior to beginning work on site. In these contacts, the Project Manager will inform the emergency units about the nature and duration of work expected to the Site and the type of contaminants and the possible health or safety effects of emergencies involving these contaminants. At this time, the Project Manager and the emergency response units shall make the necessary arrangements to be prepared for any emergencies that could occur.

The Project Manager shall implement the contingency plan whenever conditions at the Site warrant such action. The Project Manager will be responsible for coordination of the evacuation emergency treatment, and transportation of site personnel as necessary, and notification of emergency response units and the appropriate management staff.

The cases where the PM is not available, the SSO shall serve as the alternate emergency coordinator.

EVACUATION

In the event of an emergency situation, such as fire, explosion, or significant release of toxic gases, an air horn or other appropriate device will be sounded for approximately 10 second intervals indicating the initiation of evacuation procedures. All personnel will evacuate and assemble near the entrance to the site. The location shall be upwind of the Site where possible.
For efficient and safe site evacuation and assessment of the emergency situation, the Project Manager will have authority to initiate action if outside services are

required. Under no circumstances will incoming personnel or visitors be allowed to proceed into the area once the emergency signal has been given. The SSO or designated SSO must ensure that access for emergency equipment is provided and that all combustion apparatuses have been shut down once the alarm has been sounded. Once the safety of all personnel is established, the Fire Department and other emergency response groups as necessary will be notified by telephone of the emergency.

POTENTIAL OR ACTUAL FIRE OR EXPLOSION

Immediately evacuate the Site (air horn will sound for 10-second intervals), notify the local fire and police departments, and other appropriate emergency response groups if an actual fire or explosion has taken place.

PERSONNEL INJURY

Emergency first aid shall be applied on site as deemed necessary. If necessary, the individual shall be decontaminated and transported to the nearest medical facility.

The ambulance/rescue squad shall be contacted for transport as necessary in an emergency. However, since some situations may require transport of an injured party by other means, the hospital route is identified below. A map to this facility provided with this HASP in Section 2.2.3.

ACCIDENT/INCIDENT REPORTING

As soon as first aid and/or emergency response needs have been met, the following parties are to be contacted by telephone:

1. Ruijie Xu - Cell phone (631) 229-7090
2. The employer of any injured worker if not an HydroTech employee

Written confirmation of verbal reports is to be submitted within 24 hours. The report form entitled “Accident Data Report” is to be used for this purpose. All HydroTech representatives contacted by telephone are to receive a copy of this report. If the employee involved is not a HydroTech employee, his employer shall receive a copy of this report.

For reporting purposes, the term accident refers to fatalities, lost time injuries, spill or exposure to hazardous materials (toxic materials, explosive or flammable materials).

Any information released from the health care provider, which is not deemed confidential patient information, is to be attached to the appropriate form. Any medical information that is released by patient consent is to be filed in the individuals' medical records and treated as confidential.

OVERT PERSONNEL EXPOSURE

SKIN CONTACT:	Use copious amounts of soap and water. Wash/rinse affected area thoroughly, and then provide appropriate medical attention. Eyes should be rinsed for 15 minutes upon chemical contamination.
INHALATION:	Move personnel to fresh air and if necessary, decontaminate and transport to hospital.
INGESTION:	Decontamination and transport to emergency medical facility.
PUNCTURE WOUND OR LACERATION:	Decontaminate and transport to emergency medical facility.

ADVERSE WEATHER CONDITIONS

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

- Potential for heat stress and heat-related injuries
- Potential for cold stress and cold-related injuries
- Treacherous weather-related conditions
- Limited visibility
- Potential for electrical storms

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

EMERGENCY RESPONSE EQUIPMENT LIST

Some or all of the following will either be available onsite or be able to be brought to the Site within a 2-hour period:

- 55 Gallon Drums
- 85 Gallon Drums
- Absorbent Pads
- Absorbent Booms
- Speedy-Dry
- Plastic Sheeting
- Hay Bales
- Pneumatic Nibbler
- Back Hoe
- Pressure Washer
- Air Compressor
- Wilden Pumps
- Equipment Storage Trailer
- Submersible Pumps
- Miscellaneous Hand Tools
- Portable Lighting

LARGE EQUIPMENT

If necessary, HydroTech can have the following large equipment brought to the Site within 2-hours:

- Large Vacuum Truck
- Super Sucker
- Dump Trucks
- Drill Rig
- Utility Vehicle

12.0 Logs, Reports and Record Keeping

MEDICAL AND TRAINING RECORDS

The employer keeps medical and training records. All subcontractors must provide verification of training and medical qualifications to the SSO. The SSO will keep a log of personnel meeting appropriate training and medical qualifications for site work. The log will be kept in the project file. Medical records will be maintained in accordance with 29 CFR 1910.20.

ONSITE LOG

A log of personnel onsite each day will be kept by the SSO or designee. A copy of these logs will be sent to the HydroTech records coordinator for data entry. Originals will be kept in the project file.

EXPOSURE RECORDS

Any personal monitoring results, laboratory reports, calculations and air sampling data sheets are part of an employee exposure record. These records will be kept in accordance with 29 CFR 1910.20. For HydroTech employees, the originals will be sent to the HydroTech records coordinator. For subcontractor employees, the original will be sent to the subcontractor employer and a copy kept in the project file.

ACCIDENT/INCIDENT REPORTS

An accident/incident report must be completed for all accidents and incidents. The originals will be sent to the appropriate HydroTech records coordinator for maintenance by HydroTech. Copies will be distributed as stated. A copy of the Accident/Incident Reporting Log is included in **Attachment B**. A copy of the forms will be kept in the project file.

OSHA FORM 200

An OSHA Form 200 (Log of Occupational Injuries and Illnesses) will be kept at the Site. All recordable injuries or illnesses will be recorded on this form. At the end of the project, the original will be sent to the HydroTech corporate records administrator for maintenance. Subcontractor employers must also meet the requirements of maintaining an OSHA 200 form.

The HydroTech accident/incident report meets the requirements of the OSHA

Form 101 (Supplemental Record) and must be maintained with the OSHA Form 200 for all recordable injuries or illnesses.

HEALTH AND SAFETY FIELD LOG BOOK

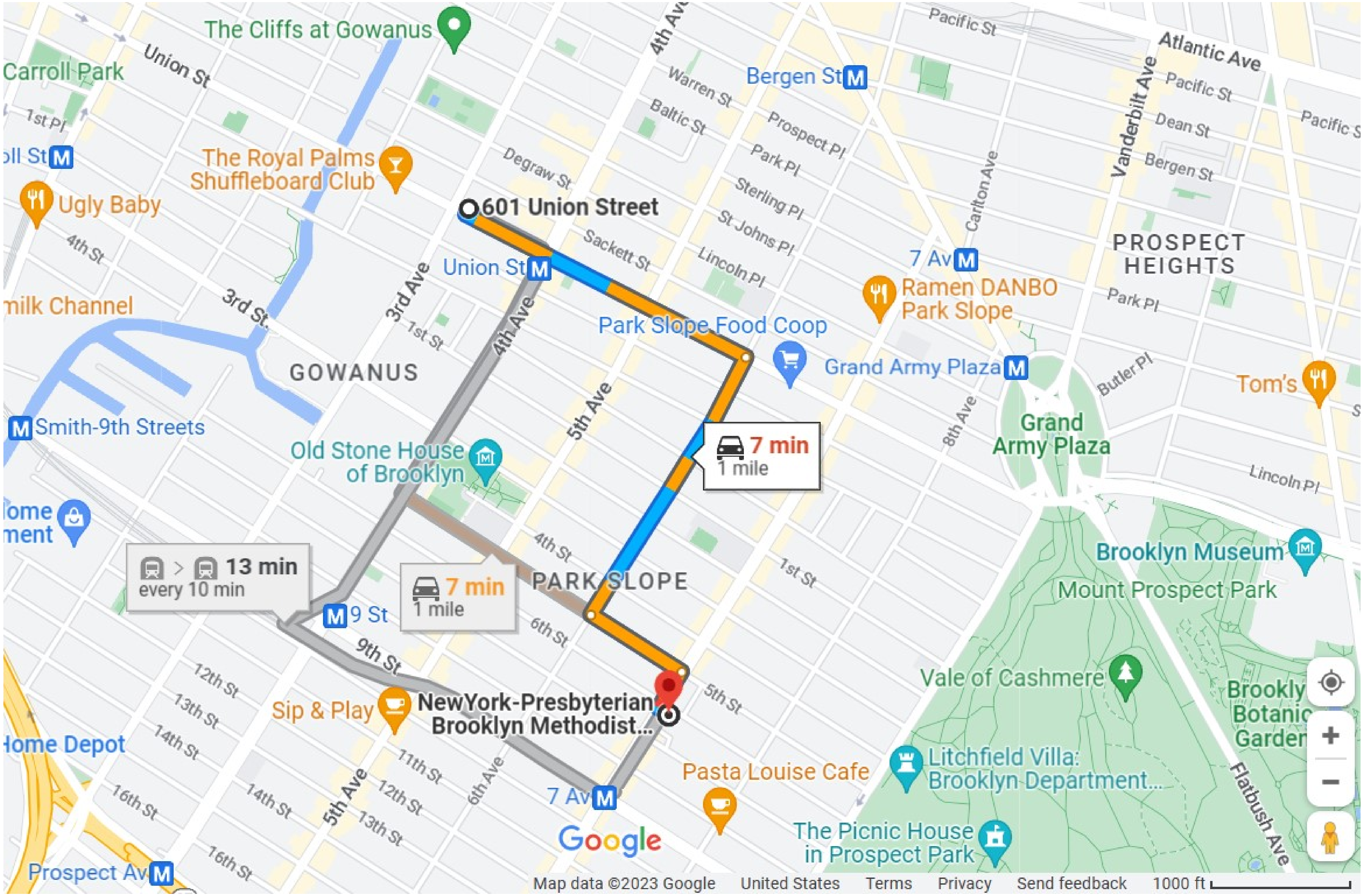
The SSO or designee will maintain the logbook in accordance with standard HydroTech procedures. Daily site conditions, activities, personnel, calibration records, monitoring results and significant events will be recorded. The original logbooks will become part of the exposure records file.

13.0 Sanitation

If sanitary sewers are not provided at the Site, provisions shall be made for access to sanitary systems by using nearby public facilities consistent with provisions of governing local ordinance codes. In the latter case, provisions are required for the removal of accumulated waste products within those units.

If a commercial/industrial laundry is used to clean or launder clothing that is potentially contaminated, they shall be informed of the potential harmful effects of exposure to hazardous substances related to the affected clothing.

Personnel and subcontractors sites shall follow decontamination procedures described in the HASP, or as directed by the SSO. This will generally include at a minimum site-specific training in shower usage and cleanup, personal hygiene requirements and the donning of protective equipment/clothing.



DATE	DESCRIPTION	CHK

SEAL & SIGNATURE

HYDROTECH ENVIRONMENTAL ENGINEERING AND GEOLOGY, DPC

231 WEST 29TH STREET, SUITE 1104
MANHATTAN, NY 10001

TEL: (631) 462-5866

BASE DRAWING PREPARED BY
GOOGLE MAPS

PROJECT NAME AND ADDRESS
601-607 UNION STREET, BROOKLYN

PROJECT FIGURE
FIGURE 1: DIRECTIONS TO HOSPITAL

PROJECT NO. 220073	DATE 03/09/2023
DRAWN BY N.P.	REVIEWED BY R.X.
SCALE (11X17) AS NOTED	APPROVED BY T.K.

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 03-Feb-2010 **Revision Date** 23-Jan-2018 **Revision Number** 4

1. Identification

Product Name	**Trichloroethylene**
Cat No. :	**AC421520000; AC421520025; AC421525000**
CAS-No	79-01-6
Synonyms	Triclene; Trichloroethene; Ethylene trichloride
Recommended Use	Laboratory chemicals.
Uses advised against	

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1A
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Heart, spleen, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness

Suspected of causing genetic defects
May cause cancer
May cause 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
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Skin
IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention
Eyes
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 advice/attention
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)
Harmful to aquatic life with long lasting effects
WARNING. Cancer and Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Trichloroethylene	79-01-6	>95

4. First-aid measures

General Advice	Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.
Eye Contact	In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation	Move to fresh air. If not breathing, give artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.
Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	410 °C / 770 °F
Explosion Limits	
Upper	44.8 vol %
Lower	8 vol %
Oxidizing Properties	Not oxidising
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Hydrogen chloride gas Chlorine Phosgene Carbon monoxide (CO) Carbon dioxide (CO_2)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
2	1	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas.
Environmental Precautions	Should not be released into the environment. Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Use only under a chemical fume hood. Do not breathe vapors or spray mist. Do not ingest.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from light. Do

not store in aluminum containers.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Trichloroethylene	TWA: 10 ppm STEL: 25 ppm	(Vacated) TWA: 50 ppm (Vacated) TWA: 270 mg/m³ Ceiling: 200 ppm (Vacated) STEL: 200 ppm (Vacated) STEL: 1080 mg/m³ TWA: 100 ppm	IDLH: 1000 ppm	TWA: 100 ppm TWA: 535 mg/m³ STEL: 200 ppm STEL: 1080 mg/m³

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 adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

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	Long sleeved clothing.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-85 °C / -121 °F
Boiling Point/Range	87 °C / 188.6 °F
Flash Point	No information available
Evaporation Rate	0.69 (Carbon Tetrachloride = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	44.8 vol %
Lower	8 vol %
Vapor Pressure	77.3 mbar @ 20 °C
Vapor Density	4.5 (Air = 1.0)
Specific Gravity	1.460
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	410 °C / 770 °F
Decomposition Temperature	> 120°C

Viscosity	0.55 mPa.s (25°C)
Molecular Formula	C2 H Cl3
Molecular Weight	131.39

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Light sensitive.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to light. Exposure to moist air or water.
Incompatible Materials	Strong oxidizing agents, Strong bases, Amines, Alkali metals, Metals,
Hazardous Decomposition Products	Hydrogen chloride gas, Chlorine, Phosgene, Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Trichloroethylene	LD50 = 4920 mg/kg (Rat) LD50 = 4290 mg/kg (Rat)	LD50 = 29000 mg/kg (Rabbit) LD50 > 20 g/kg (Rabbit)	LC50 = 26 mg/L (Rat) 4 h

Toxicologically Synergistic Products	No information available

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

Irritation	Irritating to eyes and skin
Sensitization	May cause sensitization by skin contact
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Trichloroethylene	79-01-6	Group 1	Known Reasonably Anticipated	A2	X	Not listed

IARC: (International Agency for Research on Cancer)	*IARC: (International Agency for Research on Cancer)* *Group 1 - Carcinogenic to Humans* *Group 2A - Probably Carcinogenic to Humans* *Group 2B - Possibly Carcinogenic to Humans*
NTP: (National Toxicity Program)	*NTP: (National Toxicity Program)* *Known - Known Carcinogen* *Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen*
ACGIH: (American Conference of Governmental Industrial Hygienists)	*A1 - Known Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Animal Carcinogen* *ACGIH: (American Conference of Governmental Industrial Hygienists)*

Mutagenic Effects	Mutagenic effects have occurred in humans.
Reproductive Effects	No information available.
Developmental Effects	No information available.

Teratogenicity	No information available.
STOT - single exposure	Central nervous system (CNS)
STOT - repeated exposure	Kidney Liver Heart spleen Blood
Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment. Do not empty into drains. The product contains following substances which are hazardous for the environment. Contains a substance which is:. Harmful to aquatic organisms. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Trichloroethylene	EC50: = 175 mg/L, 96h (Pseudokirchneriella subcapitata) EC50: = 450 mg/L, 96h (Desmodesmus subspicatus)	LC50: 31.4 - 71.8 mg/L, 96h flow-through (Pimephales promelas) LC50: 39 - 54 mg/L, 96h static (Lepomis macrochirus)	EC50 = 0.81 mg/L 24 h EC50 = 115 mg/L 10 min EC50 = 190 mg/L 15 min EC50 = 235 mg/L 24 h EC50 = 410 mg/L 24 h EC50 = 975 mg/L 5 min	EC50: = 2.2 mg/L, 48h (Daphnia magna)

Persistence and Degradability	Persistence is unlikely based on information available.
Bioaccumulation/ Accumulation	No information available.
Mobility	Will likely be mobile in the environment due to its volatility.

Component	log Pow
Trichloroethylene	2.4

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
Trichloroethylene - 79-01-6	U228	-

14. Transport information

DOT

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

TDG

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IATA

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IMDG/IMO

UN-No	UN1710
Proper Shipping Name	TRICHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Trichloroethylene	X	X	-	201-167-4	-		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

Component	TSCA 12(b)
Trichloroethylene	Section 5 Section 6

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Trichloroethylene	79-01-6	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Trichloroethylene	X	100 lb	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Trichloroethylene	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
Trichloroethylene	100 lb 1 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Trichloroethylene	79-01-6	Carcinogen Developmental Male Reproductive	14 µg/day 50 µg/day	Developmental Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Trichloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
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-Feb-2010
Revision Date	23-Jan-2018
Print Date	23-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

ThermoFisher
SCIENTIFIC

SAFETY DATA SHEET

Creation Date 10-Dec-2009 **Revision Date** 23-Jan-2018 **Revision Number** 5

1. Identification

Product Name	**Tetrachloroethylene**
Cat No. :	**AC445690000; ACR445690010; AC445690025; AC445691000**
CAS-No	127-18-4
Synonyms	Perchloroethylene
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

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Skin Sensitization	Category 1
Carcinogenicity	Category 1B
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Central nervous system (CNS).	
Specific target organ toxicity - (repeated exposure)	Category 2
Target Organs - Kidney, Liver, Blood.	

Label Elements

Signal Word
Danger

Hazard Statements
Causes skin irritation
Causes serious eye irritation
May cause an allergic skin reaction
May cause drowsiness or dizziness
May cause cancer
May cause 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
Contaminated work clothing should not be allowed out of the workplace
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wear protective gloves/protective clothing/eye protection/face protection

Response

IF exposed or concerned: Get medical attention/advice

Inhalation

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing

Skin

IF ON SKIN: Wash with plenty of soap and water
Take off contaminated clothing and wash before reuse
If skin irritation or rash occurs: Get medical advice/attention

Eyes

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 advice/attention

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
WARNING. Cancer - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Tetrachloroethylene	127-18-4	>95

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Inhalation	Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.
Ingestion	Clean mouth with water and drink afterwards plenty of water.

Most important symptoms and effects	None reasonably foreseeable. May cause allergic skin reaction. Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	No information available
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Containers may explode when heated.

Hazardous Combustion Products
Chlorine Hydrogen chloride gas Phosgene
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Ensure adequate ventilation.
Environmental Precautions	Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Ensure adequate ventilation. Avoid ingestion and inhalation.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Protect from sunlight.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Tetrachloroethylene	TWA: 25 ppm STEL: 100 ppm	(Vacated) TWA: 25 ppm (Vacated) TWA: 170 mg/m^3 Ceiling: 200 ppm TWA: 100 ppm	IDLH: 150 ppm	TWA: 100 ppm TWA: 670 mg/m^3 TWA: 200 ppm TWA: 1250 mg/m^3 STEL: 200 ppm STEL: 1340 mg/m^3

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

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 Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	Characteristic, sweet
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-22 °C / -7.6 °F
Boiling Point/Range	120 - 122 °C / 248 - 251.6 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	6.0 (Ether = 1.0)
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	18 mbar @ 20 °C
Vapor Density	No information available
Density	1.619
Specific Gravity	1.625
Solubility	0.15 g/L water (20°C)
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	> 150°C
Viscosity	0.89 mPa s at 20 °C
Molecular Formula	C_2Cl_4
Molecular Weight	165.83

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Exposure to moist air or water.
Incompatible Materials	Strong acids, Strong oxidizing agents, Strong bases, Metals, Zinc, Amines, Aluminium
Hazardous Decomposition Products	Chlorine, Hydrogen chloride gas, Phosgene
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tetrachloroethylene	LD50 = 2629 mg/kg (Rat)	LD50 > 10000 mg/kg (Rat)	LC50 = 27.8 mg/L (Rat) 4 h

Toxicologically Synergistic Products No information available

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

Irritation	Irritating to eyes and skin
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Tetrachloroethylene	127-18-4	Group 2A	Reasonably Anticipated	A3	X	A3

IARC: (International Agency for Research on Cancer)	*IARC: (International Agency for Research on Cancer)* *Group 1 - Carcinogenic to Humans* *Group 2A - Probably Carcinogenic to Humans* *Group 2B - Possibly Carcinogenic to Humans*
NTP: (National Toxicity Program)	*NTP: (National Toxicity Program)* *Known - Known Carcinogen* *Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen*
ACGIH: (American Conference of Governmental Industrial Hygienists)	*A1 - Known Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Animal Carcinogen* *ACGIH: (American Conference of Governmental Industrial Hygienists)*
Mexico - Occupational Exposure Limits - Carcinogens	*Mexico - Occupational Exposure Limits - Carcinogens* *A1 - Confirmed Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Confirmed Animal Carcinogen* *A4 - Not Classifiable as a Human Carcinogen* *A5 - Not Suspected as a Human Carcinogen*

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	Central nervous system (CNS)

STOT - repeated exposure Kidney Liver Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Inhalation of high vapor concentrations may cause symptoms like headache, dizziness, tiredness, nausea and vomiting: Symptoms of allergic reaction may include rash, itching, swelling, trouble breathing, tingling of the hands and feet, dizziness, lightheadedness, chest pain, muscle pain or flushing

Endocrine Disruptor Information

Component	EU - Endocrine Disrupters Candidate List	EU - Endocrine Disruptors - Evaluated Substances	Japan - Endocrine Disruptor Information
Tetrachloroethylene	Group II Chemical	Not applicable	Not applicable

Other Adverse Effects Tumorigenic effects have been reported in experimental animals.

12. Ecological information

Ecotoxicity

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Tetrachloroethylene	EC50: > 500 mg/L, 96h (Pseudokirchneriella subcapitata)	LC50: 4.73 - 5.27 mg/L, 96h flow-through (Oncorhynchus mykiss) LC50: 11.0 - 15.0 mg/L, 96h static (Lepomis macrochirus) LC50: 8.6 - 13.5 mg/L, 96h static (Pimephales promelas) LC50: 12.4 - 14.4 mg/L, 96h flow-through (Pimephales promelas)	EC50 = 100 mg/L 24 h EC50 = 112 mg/L 24 h EC50 = 120.0 mg/L 30 min	EC50: 6.1 - 9.0 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability Insoluble in water Persistence is unlikely based on information available.

Bioaccumulation/ Accumulation No information available.

Mobility . Is not likely mobile in the environment due its low water solubility. Will likely be mobile in the environment due to its volatility.

Component	log Pow
Tetrachloroethylene	2.53 - 2.88

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
Tetrachloroethylene - 127-18-4	U210	-

14. Transport information

DOT

UN-No	UN1897
Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

TDG

UN-No	UN1897

Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IATA

UN-No	UN1897
Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Packing Group	III

IMDG/IMO

UN-No	UN1897
Proper Shipping Name	TETRACHLOROETHYLENE
Hazard Class	6.1
Subsidiary Hazard Class	P
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Tetrachloroethylene	X	X	-	204-825-9	-		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 %
Tetrachloroethylene	127-18-4	>95	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Tetrachloroethylene	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Tetrachloroethylene	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
Tetrachloroethylene	100 lb 1 lb	-

California Proposition 65	This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Tetrachloroethylene	127-18-4	Carcinogen	14 µg/day	Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Tetrachloroethylene	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ):	Y
DOT Marine Pollutant	Y
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	10-Dec-2009
Revision Date	23-Jan-2018
Print Date	23-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer
The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Creation Date 31-May-2018 **Revision Date** 04-Jun-2018 **Revision Number** 7

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product identification

Product Description:	**Xylenes, mixture of isomers**
Cat No. :	**383940000; 383940010; 383940050**
CAS-No	1330-20-7
EC-No.	215-535-7
Molecular Formula	C8 H10

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

Recommended Use	Laboratory chemicals.
Sector of use	SU3 - Industrial uses: Uses of substances as such or in preparations at industrial sites
Product category	PC21 - Laboratory chemicals
Process categories	PROC15 - Use as a laboratory reagent
Environmental release category	ERC6a - Industrial use resulting in manufacture of another substance (use of intermediates)
Uses advised against	No Information available

1.3. Details of the supplier of the safety data sheet

Company	Acros Organics BVBA Janssen Pharmaceuticalaan 3a 2440 Geel, Belgium
E-mail address	begel.sdsdesk@thermofisher.com

1.4. Emergency telephone number

For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

CLP Classification - Regulation (EC) No 1272/2008

Physical hazards

Flammable liquids	Category 3 (H226)

Health hazards

Aspiration Toxicity	Category 1 (H304)
Acute dermal toxicity	Category 4 (H312)
Acute Inhalation Toxicity - Vapors	Category 4 (H332)
Skin Corrosion/irritation	Category 2 (H315)
Serious Eye Damage/Eye Irritation	Category 2 (H319)
Specific target organ toxicity - (single exposure)	Category 3 (H335)
Specific target organ toxicity - (repeated exposure)	Category 2 (H373)

Environmental hazards

Chronic aquatic toxicity	Category 3 (H412)

2.2. Label elements

Signal Word	**Danger**

Hazard Statements

H226 - Flammable liquid and vapor
H304 - May be fatal if swallowed and enters airways
H312 - Harmful in contact with skin
H332 - Harmful if inhaled
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation
H373 - May cause damage to organs through prolonged or repeated exposure
H412 - Harmful to aquatic life with long lasting effects

Precautionary Statements

P210 - Keep away from heat/sparks/open flames/hot surfaces. - No smoking
P303 + P361 + P353 - IF ON SKIN (or hair): Remove/ Take off immediately all contaminated clothing. Rinse skin with water/ shower
P301 + P310 - IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician
P331 - Do NOT induce vomiting
P304 + P340 - IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing
P264 - Wash face, hands and any exposed skin thoroughly after handling
P337 + P313 - If eye irritation persists: Get medical advice/ attention
P280 - Wear protective gloves/ protective clothing/ eye protection/ face protection
P332 + P313 - If skin irritation occurs: Get medical advice/ attention

2.3. Other hazards

No information available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1. Substances

Component	CAS-No	EC-No.	Weight %	CLP Classification - Regulation (EC) No 1272/2008
Xylenes (o-, m-, p- isomers)	1330-20-7	EEC No. 215-535-7	>95	Flam. Liq. 3 (H226) Asp. Tox. 1 (H304) Acute Tox. 4 (H312) Acute Tox. 4 (H332)

				Skin Irrit. 2 (H315) Eye Irrit. 2 (H319) STOT SE 3 (H335) STOT RE 2 (H373) Aquatic Chronic 3 (H412)

Full text of Hazard Statements: see section 16

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs naturally, have victim lean forward.
Inhalation	Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur. Risk of serious damage to the lungs.
Self-Protection of the First Aider	Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination.

4.2. Most important symptoms and effects, both acute and delayed

Breathing difficulties. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting

4.3. Indication of any immediate medical attention and special treatment needed

Notes to Physician	Treat symptomatically. Symptoms may be delayed.

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

Suitable Extinguishing Media
Cool closed containers exposed to fire with water spray.

Extinguishing media which must not be used for safety reasons
Do not use a solid water stream as it may scatter and spread fire.

5.2. Special hazards arising from the substance or mixture

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products
None under normal use conditions.

5.3. Advice for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

Ensure adequate ventilation. Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges.

6.2. Environmental precautions

Do not flush into surface water or sanitary sewer system.

6.3. Methods and material for containment and cleaning up

Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Take precautionary measures against static discharges. Use spark-proof tools and explosion-proof equipment.

6.4. Reference to other sections

Refer to protective measures listed in Sections 8 and 13.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

Wear personal protective equipment. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Use explosion-proof equipment. Take precautionary measures against static discharges.

Hygiene Measures
Handle in accordance with good industrial hygiene and safety practice. Keep away from food, drink and animal feeding stuffs. Do not eat, drink or smoke when using this product. Remove and wash contaminated clothing before re-use. Wash hands before breaks and at the end of workday.

7.2. Conditions for safe storage, including any incompatibilities

Keep away from heat and sources of ignition. Flammables area. Keep container tightly closed in a dry and well-ventilated place.

7.3. Specific end use(s)

Use in laboratories

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

Exposure limits
List source(s): **EU** - Commission Directive 2006/15/EC of 7 February 2006 establishing a second list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC and amending Directives 91/322/EEC and 2000/39/EC on the protection of the health and safety of workers from the risks related to chemical agents at work. **UK** - EH40/2005 Containing the workplace exposure limits (WELs) for use with the Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended). Updated by September 2006 official press release and October 2007 Supplement. **IRE -** 2010 Code of Practice for the

Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001. Published by the Health and Safety Authority.

Component	The United Kingdom	European Union	Ireland
Xylenes (o-, m-, p- isomers)	STEL: 100 ppm 15 min STEL: 441 mg/m³ 15 min TWA: 50 ppm 8 hr TWA: 220 mg/m³ 8 hr Skin	TWA: 50 ppm 8 hr TWA: 221 mg/m³ 8 hr STEL: 100 ppm 15 min STEL: 442 mg/m³ 15 min Possibility of significant uptake through the skin	TWA: 50 ppm 8 hr. TWA: 221 mg/m³ 8 hr. STEL: 100 ppm 15 min STEL: 442 mg/m³ 15 min Skin

Biological limit values
List source(s): **UK** - Biological Monitoring Guidance Values provided by the UK's Health and Safety Executive (HSE) Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended) and EH40/2005.

Component	United Kingdom	European Union
Xylenes (o-, m-, p- isomers)	Methyl hippuric acid: 650 mmol/mol creatinine urine post shift	

Monitoring methods
BS EN 14042:2003 Title Identifier: Workplace atmospheres. Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents.
MDHS70 General methods for sampling airborne gases and vapours
MDHS 88 Volatile organic compounds in air. Laboratory method using diffusive samplers, solvent desorption and gas chromatography
MDHS 96 Volatile organic compounds in air - Laboratory method using pumped solid sorbent tubes, solvent desorption and gas chromatography

Derived No Effect Level (DNEL) No information available

Route of exposure	Acute effects (local)	Acute effects (systemic)	Chronic effects (local)	Chronic effects (systemic)
Oral				
Dermal				
Inhalation				

Predicted No Effect Concentration (PNEC) No information available.

8.2. Exposure controls

Engineering Measures
Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment.
Wherever possible, engineering control measures such as the isolation or enclosure of the process, the introduction of process or equipment changes to minimise release or contact, and the use of properly designed ventilation systems, should be adopted to control hazardous materials at source

Personal protective equipment

Eye Protection Goggles (European standard - EN 166)

Hand Protection Protective gloves

Glove material	Breakthrough time	Glove thickness	EU standard	Glove comments
Viton (R)	See manufacturers recommendations	-	EN 374	(minimum requirement)

Skin and body protection Long sleeved clothing

Inspect gloves before use.
Please observe the instructions regarding permeability and breakthrough time which are provided by the supplier of the gloves. (Refer to manufacturer/supplier for information)

Ensure gloves are suitable for the task: Chemical compatability, Dexterity, Operational conditions, User susceptibility, e.g. sensitisation effects, also take into consideration the specific local conditions under which the product is used, such as the danger of cuts, abrasion.
Remove gloves with care avoiding skin contamination.

Respiratory Protection	When workers are facing concentrations above the exposure limit they must use appropriate certified respirators. To protect the wearer, respiratory protective equipment must be the correct fit and be used and maintained properly
Large scale/emergency use	Use a NIOSH/MSHA or European Standard EN 136 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced **Recommended Filter type:** Organic gases and vapours filter Type A Brown conforming to EN14387
Small scale/Laboratory use	Use a NIOSH/MSHA or European Standard EN 149:2001 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced. **Recommended half mask:-** Valve filtering: EN405; or; Half mask: EN140; plus filter, EN 141 When RPE is used a face piece Fit Test should be conducted
Environmental exposure controls	Prevent product from entering drains. Do not allow material to contaminate ground water system. Local authorities should be advised if significant spillages cannot be contained.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance		
Physical State	Liquid	
Odor	No information available	
Odor Threshold	No data available	
pH	No information available	
Melting Point/Range	-34 °C / -29.2 °F	
Softening Point	No data available	
Boiling Point/Range	136 - 140 °C / 276.8 - 284 °F	@ 760 mmHg
Flash Point	23 °C / 73.4 °F	**Method -** No information available
Evaporation Rate	No data available	
Flammability (solid,gas)	Not applicable	Liquid
Explosion Limits	No data available	
Vapor Pressure	No data available	
Vapor Density	No data available	(Air = 1.0)
Specific Gravity / Density	0.865	
Bulk Density	Not applicable	Liquid
Water Solubility	Insoluble	
Solubility in other solvents	No information available	
Partition Coefficient (n-octanol/water)		
Component	**log Pow**	
Xylenes (o-, m-, p- isomers)	3.15	
Autoignition Temperature	No data available	
Decomposition Temperature	No data available	
Viscosity	No data available	
Explosive Properties	No information available	explosive air/vapour mixtures possible
Oxidizing Properties	No information available	

9.2. Other information

Molecular Formula C8 H10

Molecular Weight	106.17

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

None known, based on information available

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

Hazardous Polymerization	No information available.
Hazardous Reactions	None under normal processing.

10.4. Conditions to avoid

Keep away from open flames, hot surfaces and sources of ignition.

10.5. Incompatible materials

None known.

10.6. Hazardous decomposition products

None under normal use conditions.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

Product Information

(a) acute toxicity;

Oral	Based on available data, the classification criteria are not met
Dermal	Category 4
Inhalation	Category 4

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Xylenes (o-, m-, p- isomers)	LD50 = 3500 mg/kg (Rat)		29.08 mg/L [MOE Risk Assessment Vol.1, 2002]

(b) skin corrosion/irritation;	Category 2
(c) serious eye damage/irritation;	Category 2

(d) respiratory or skin sensitization;

Respiratory	Based on available data, the classification criteria are not met
Skin	Based on available data, the classification criteria are not met

(e) germ cell mutagenicity;	Based on available data, the classification criteria are not met
(f) carcinogenicity;	Based on available data, the classification criteria are not met

There are no known carcinogenic chemicals in this product

(g) reproductive toxicity;	Based on available data, the classification criteria are not met

(h) STOT-single exposure; Category 3

Results / Target organs Respiratory system.

(i) STOT-repeated exposure; Category 2

Target Organs No information available.

(j) aspiration hazard; Category 1

Symptoms / effects,both acute and delayed Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Ecotoxicity effects The product contains following substances which are hazardous for the environment. Contains a substance which is:. Very toxic to aquatic organisms.

Component	Freshwater Fish	Water Flea	Freshwater Algae	Microtox
Xylenes (o-, m-, p- isomers)	LC50: 13.1 - 16.5 mg/L, 96h flow-through (Lepomis macrochirus) LC50: = 19 mg/L, 96h (Lepomis macrochirus) LC50: 7.711 - 9.591 mg/L, 96h static (Lepomis macrochirus) LC50: 23.53 - 29.97 mg/L, 96h static (Pimephales promelas) LC50: = 780 mg/L, 96h semi-static (Cyprinus carpio) LC50: > 780 mg/L, 96h (Cyprinus carpio) LC50: 30.26 - 40.75 mg/L, 96h static (Poecilia reticulata) LC50: 13.5 - 17.3 mg/L, 96h (Oncorhynchus mykiss) LC50: = 13.4 mg/L, 96h flow-through (Pimephales promelas) LC50: 2.661 - 4.093 mg/L, 96h static (Oncorhynchus mykiss)	EC50: = 3.82 mg/L, 48h (water flea) LC50: = 0.6 mg/L, 48h (Gammarus lacustris)		EC50 = 0.0084 mg/L 24 h

12.2. Persistence and degradability

Persistence Persistence is unlikely.

Degradation in sewage treatment plant Contains substances known to be hazardous to the environment or not degradable in waste water treatment plants.

12.3. Bioaccumulative potential

Bioaccumulation is unlikely

Component	log Pow	Bioconcentration factor (BCF)
Xylenes (o-, m-, p- isomers)	3.15	0.6 - 15

12.4. Mobility in soil	Spillage unlikely to penetrate soil The product is insoluble and floats on water Is not likely mobile in the environment due its low water solubility.
12.5. Results of PBT and vPvB assessment	No data available for assessment.

12.6. Other adverse effects

Endocrine Disruptor Information	This product does not contain any known or suspected endocrine disruptors
Persistent Organic Pollutant	This product does not contain any known or suspected substance
Ozone Depletion Potential	This product does not contain any known or suspected substance

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Waste from Residues / Unused Products	Waste is classified as hazardous. Dispose of in accordance with the European Directives on waste and hazardous waste. Dispose of in accordance with local regulations.
Contaminated Packaging	Dispose of this container to hazardous or special waste collection point. Empty containers retain product residue, (liquid and/or vapor), and can be dangerous. Keep product and empty container away from heat and sources of ignition.
European Waste Catalogue (EWC)	According to the European Waste Catalogue, Waste Codes are not product specific, but application specific.
Other Information	Do not dispose of waste into sewer. Waste codes should be assigned by the user based on the application for which the product was used. Can be incinerated, when in compliance with local regulations. Do not let this chemical enter the environment. Do not empty into drains.

SECTION 14: TRANSPORT INFORMATION

IMDG/IMO

14.1. UN number	UN1307
14.2. UN proper shipping name	XYLENES
14.3. Transport hazard class(es)	3
14.4. Packing group	III

ADR

14.1. UN number	UN1307
14.2. UN proper shipping name	XYLENES
14.3. Transport hazard class(es)	3
14.4. Packing group	III

IATA

14.1. UN number	UN1307
14.2. UN proper shipping name	XYLENES
14.3. Transport hazard class(es)	3
14.4. Packing group	III

14.5. Environmental hazards	No hazards identified
14.6. Special precautions for user	No special precautions required

14.7. Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code Not applicable, packaged goods

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

International Inventories X = listed.

Component	EINECS	ELINCS	NLP	TSCA	DSL	NDSL	PICCS	ENCS	IECSC	AICS	KECL
Xylenes (o-, m-, p- isomers)	215-535-7	-		X	X	-	X	X	X	X	X

National Regulations

Component	Germany - Water Classification (VwVwS)	Germany - TA-Luft Class
Xylenes (o-, m-, p- isomers)	WGK 2	

Component	France - INRS (Tables of occupational diseases)
Xylenes (o-, m-, p- isomers)	Tableaux des maladies professionnelles (TMP) - RG 4bis,RG 84

Take note of Control of Substances Hazardous to Health Regulations (COSHH) 2002 and 2005 Amendment.

15.2. Chemical safety assessment

A Chemical Safety Assessment/Report (CSA/CSR) has not been conducted

SECTION 16: OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3

H304 - May be fatal if swallowed and enters airways
H312 - Harmful in contact with skin
H332 - Harmful if inhaled
H315 - Causes skin irritation
H319 - Causes serious eye irritation
H335 - May cause respiratory irritation
H373 - May cause damage to organs through prolonged or repeated exposure
H412 - Harmful to aquatic life with long lasting effects
H226 - Flammable liquid and vapor

Legend

CAS - Chemical Abstracts Service
EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances
PICCS - Philippines Inventory of Chemicals and Chemical Substances
IECSC - Chinese Inventory of Existing Chemical Substances
KECL - Korean Existing and Evaluated Chemical Substances
TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL/NDSL - Canadian Domestic Substances List/Non-Domestic Substances List
ENCS - Japanese Existing and New Chemical Substances
AICS - Australian Inventory of Chemical Substances
NZIoC - New Zealand Inventory of Chemicals

WEL - Workplace Exposure Limit
ACGIH - American Conference of Governmental Industrial Hygienists
DNEL - Derived No Effect Level
RPE - Respiratory Protective Equipment
LC50 - Lethal Concentration 50%
NOEC - No Observed Effect Concentration
PBT - Persistent, Bioaccumulative, Toxic
TWA - Time Weighted Average
IARC - International Agency for Research on Cancer
PNEC - Predicted No Effect Concentration
LD50 - Lethal Dose 50%
EC50 - Effective Concentration 50%
POW - Partition coefficient Octanol:Water
vPvB - very Persistent, very Bioaccumulative

ADR - European Agreement Concerning the International Carriage of Dangerous Goods by Road
IMO/IMDG - International Maritime Organization/International Maritime Dangerous Goods Code
OECD - Organisation for Economic Co-operation and Development
BCF - Bioconcentration factor
ICAO/IATA - International Civil Aviation Organization/International Air Transport Association
MARPOL - International Convention for the Prevention of Pollution from Ships
ATE - Acute Toxicity Estimate
VOC - Volatile Organic Compounds

Key literature references and sources for data

Suppliers safety data sheet, Chemadvisor - LOLI, Merck index, RTECS

Training Advice

Chemical hazard awareness training, incorporating labelling, Safety Data Sheets (SDS), Personal Protective Equipment (PPE) and hygiene.
Use of personal protective equipment, covering appropriate selection, compatibility, breakthrough thresholds, care, maintenance, fit and standards.
First aid for chemical exposure, including the use of eye wash and safety showers.
Chemical incident response training.
Fire prevention and fighting, identifying hazards and risks, static electricity, explosive atmospheres posed by vapours and dusts.

Creation Date	31-May-2018
Revision Date	04-Jun-2018
Revision Summary	SDS sections updated, 2, 3.

Disclaimer

End of Safety Data Sheet

SAFETY DATA SHEET

Creation Date 26-Sep-2009 **Revision Date** 23-Jan-2018 **Revision Number** 4

1. Identification

Product Name	**m-Xylene**
Cat No. :	**AC610470000; AC610471000**
CAS-No	108-38-3
Synonyms	1,3-Dimethylbenzene
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

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification

This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 3
Acute dermal toxicity	Category 4
Acute Inhalation Toxicity - Vapors	Category 4
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2

Label Elements

Signal Word
Warning

Hazard Statements
Flammable liquid and vapor
Harmful in contact with skin
Causes skin irritation
Causes serious eye irritation
Harmful if inhaled

Precautionary Statements
Prevention
Wear protective gloves/protective clothing/eye protection/face protection
Avoid breathing dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Wash face, hands and any exposed skin thoroughly after handling
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell
Skin
Call a POISON CENTER or doctor/physician if you feel unwell
If skin irritation occurs: Get medical advice/attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
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 advice/attention
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store in a well-ventilated place. Keep cool
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
None identified

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
m-Xylene	108-38-3	>95

4. First-aid measures

Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.
Inhalation	Move to fresh air. 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. If not breathing, give artificial respiration.

Ingestion	Do not induce vomiting. Call a physician or Poison Control Center immediately.
Most important symptoms and effects	Breathing difficulties. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	No information available
Flash Point	25 °C / 77 °F
Method -	No information available
Autoignition Temperature	465 °C / 869 °F

Explosion Limits

Upper	7.0%
Lower	1.1%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical

Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO_2)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
2	3	0	N/A

6. Accidental release measures

Personal Precautions	Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges.
Environmental Precautions	Do not flush into surface water or sanitary sewer system.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. Take precautionary measures against static discharges.

7. Handling and storage

Handling	Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Take precautionary measures against static discharges.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Flammables area. Keep away from heat and sources of ignition.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
m-Xylene	TWA: 100 ppm STEL: 150 ppm		IDLH: 900 ppm TWA: 100 ppm TWA: 435 mg/m³ STEL: 150 ppm STEL: 655 mg/m³	TWA: 100 ppm TWA: 435 mg/m³ STEL: 150 ppm STEL: 655 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures	Ensure that eyewash stations and safety showers are close to the workstation location. Ensure adequate ventilation, especially in confined areas. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-48 °C / -54.4 °F
Boiling Point/Range	139 - 139 °C / 282.2 - 282.2 °F
Flash Point	25 °C / 77 °F
Evaporation Rate	0.7
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	7.0%
Lower	1.1%
Vapor Pressure	8 mbar @ 20 °C
Vapor Density	3.66
Specific Gravity	0.864
Solubility	slightly soluble
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	465 °C / 869 °F
Decomposition Temperature	No information available
Viscosity	0.62 mPa.s at 20 °C
Molecular Formula	C_8H_{10}
Molecular Weight	106.17

10. Stability and reactivity

Reactive Hazard	None known, based on information available

Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents, Strong acids
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information
Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
m-Xylene	LD50 = 5 g/kg (Rat)	LD50 = 12.18 g/kg (Rabbit) LD50 = 14100 µL/kg (Rabbit)	Not listed

Toxicologically Synergistic Products No information available

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

Irritation Irritating to eyes and skin

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
m-Xylene	108-38-3	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	None known
STOT - repeated exposure	None known
Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

The product contains following substances which are hazardous for the environment. Contains a substance which is:. Toxic to aquatic organisms.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
m-Xylene	EC50: = 4.9 mg/L, 72h static (Pseudokirchneriella subcapitata)	LC50: = 8.4 mg/L, 96h semi-static (Oncorhynchus mykiss) LC50: 14.3 - 18 mg/L, 96h flow-through (Pimephales promelas) LC50: = 12.9 mg/L, 96h semi-static (Poecilia reticulata)	EC50 = 0.0084 mg/L 24 h	EC50: 2.81 - 5.0 mg/L, 48h Static (Daphnia magna)

Persistence and Degradability	Persistence is unlikely
Bioaccumulation/ Accumulation	No information available.
Mobility	Will likely be mobile in the environment due to its volatility. Is not likely mobile in the environment due its low water solubility.

Component	log Pow
m-Xylene	3.2

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.

14. Transport information

DOT

UN-No	UN1307
Proper Shipping Name	XYLENES
Hazard Class	3
Packing Group	III

TDG

UN-No	UN1307
Proper Shipping Name	XYLENES
Hazard Class	3
Packing Group	III

IATA

UN-No	UN1307
Proper Shipping Name	XYLENES
Hazard Class	3
Packing Group	III

IMDG/IMO

UN-No	UN1307
Proper Shipping Name	XYLENES
Hazard Class	3
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: X = listed

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
m-Xylene	X	X	-	203-576-3	-		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 %
m-Xylene	108-38-3	>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
m-Xylene	X	-	-	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
m-Xylene	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
m-Xylene	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
m-Xylene	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	26-Sep-2009
Revision Date	23-Jan-2018
Print Date	23-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

ThermoFisher
SCIENTIFIC

SAFETY DATA SHEET

Creation Date 26-Sep-2009 **Revision Date** 26-Jan-2018 **Revision Number** 6

1. Identification

Product Name	**Mesitylene**
Cat No. :	**AC125580000; AC125580010; AC125580025; AC125580050; AC125582500**
CAS-No	108-67-8
Synonyms	1,3,5-Trimethylbenzene
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

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable liquids	Category 3
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system, Central nervous system (CNS).	
Aspiration Toxicity	Category 1

Label Elements

Signal Word
Danger

Hazard Statements
Flammable liquid and vapor
May be fatal if swallowed and enters airways
Causes skin irritation
Causes serious eye irritation
May cause respiratory irritation
May cause drowsiness or dizziness

Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Wear protective gloves/protective clothing/eye protection/face protection
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Keep container tightly closed
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Use only non-sparking tools
Take precautionary measures against static discharge
Keep cool
Response
Get medical attention/advice if you feel unwell
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Call a POISON CENTER or doctor/physician if you feel unwell
Skin
If skin irritation occurs: Get medical advice/attention
IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower
Wash contaminated clothing before reuse
Eyes
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 advice/attention
Ingestion
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician
Do NOT induce vomiting
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
1,3,5-Trimethylbenzene	108-67-8	97-99

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get

	medical attention.
Skin Contact	Wash off immediately with soap and plenty of water while removing all contaminated clothes and shoes. Obtain medical attention.
Inhalation	Move to fresh air. If breathing is difficult, give oxygen. Obtain medical attention. Risk of serious damage to the lungs.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Do not induce vomiting. Call a physician or Poison Control Center immediately. If vomiting occurs naturally, have victim lean forward.
Most important symptoms and effects	. Breathing difficulties. Vapors may cause drowsiness and dizziness: Symptoms may be delayed: Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide. Cool closed containers exposed to fire with water spray.
Unsuitable Extinguishing Media	No information available
Flash Point	44 °C / 111.2 °F
Method -	No information available
Autoignition Temperature	550 °C / 1022 °F
Explosion Limits	
Upper	6.00%
Lower	1.00%
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Flammable. Containers may explode when heated. Vapors may form explosive mixtures with air. Vapors may travel to source of ignition and flash back.

Hazardous Combustion Products
Carbon monoxide (CO) Carbon dioxide (CO_2)
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
3	2	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Remove all sources of ignition. Take precautionary measures against static discharges.
Environmental Precautions	Do not flush into surface water or sanitary sewer system. See Section 12 for additional ecological information. Avoid release to the environment. Collect spillage.
Methods for Containment and Clean Up	Soak up with inert absorbent material. Keep in suitable, closed containers for disposal. Remove all sources of ignition. Use spark-proof tools and explosion-proof equipment. Take precautionary measures against static discharges.

7. Handling and storage

Handling	Wear personal protective equipment. Ensure adequate ventilation. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation. Keep away from open flames, hot surfaces and sources of ignition. Use only non-sparking tools. Take precautionary measures against static discharges. Use explosion-proof equipment.
Storage	Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from heat and sources of ignition. Flammables area.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
1,3,5-Trimethylbenzene			TWA: 25 ppm TWA: 125 mg/m^3	

Legend

NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures	Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location. Use explosion-proof electrical/ventilating/lighting/equipment.

Personal Protective Equipment

Eye/face Protection	Tightly fitting safety goggles. Face-shield.
Skin and body protection	Long sleeved clothing.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Liquid
Appearance	Colorless
Odor	aromatic
Odor Threshold	No information available
pH	No information available
Melting Point/Range	-45 °C / -49 °F
Boiling Point/Range	163 - 166 °C / 325.4 - 330.8 °F @ 760 mmHg
Flash Point	44 °C / 111.2 °F
Evaporation Rate	No information available
Flammability (solid,gas)	Not applicable
Flammability or explosive limits	
Upper	6.00%
Lower	1.00%
Vapor Pressure	2.5 mbar @ 20 °C
Vapor Density	4.1 (Air = 1.0)
Specific Gravity	0.868
Solubility	slightly soluble
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	550 °C / 1022 °F
Decomposition Temperature	No information available

Viscosity	No information available
Molecular Formula	C9 H12
Molecular Weight	120.19

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents, Nitric acid
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
1,3,5-Trimethylbenzene	LD50 = 5000 mg/kg (Rat)	Not listed	LC50 = 24 g/m^3 (Rat) 4 h

Toxicologically Synergistic Products No information available

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

Irritation	Irritating to eyes, respiratory system and skin
Sensitization	No information available
Carcinogenicity	The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
1,3,5-Trimethylbenzene	108-67-8	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects	Not mutagenic in AMES Test
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	Respiratory system Central nervous system (CNS)
STOT - repeated exposure	None known
Aspiration hazard	Category 1
Symptoms / effects,both acute and delayed	Vapors may cause drowsiness and dizziness: Symptoms may be delayed: Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting
Endocrine Disruptor Information	No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity
Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. The product contains following substances which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
1,3,5-Trimethylbenzene	Not listed	LC50: = 3.48 mg/L, 96h (Pimephales promelas)	Not listed	EC50: = 50 mg/L, 24h (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.

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.

14. Transport information

DOT

UN-No	UN2325
Proper Shipping Name	1,3,5-TRIMETHYLBENZENE
Hazard Class	3
Packing Group	III

TDG

UN-No	UN2325
Proper Shipping Name	1,3,5-TRIMETHYLBENZENE
Hazard Class	3
Packing Group	III

IATA

UN-No	UN2325
Proper Shipping Name	1,3,5-TRIMETHYLBENZENE
Hazard Class	3
Packing Group	III

IMDG/IMO

UN-No	UN2325
Proper Shipping Name	1,3,5-TRIMETHYLBENZENE
Hazard Class	3
Packing Group	III

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 Europe 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
1,3,5-Trimethylbenzene	X	X	-	203-604-4	-		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	Not applicable
SARA 311/312 Hazard Categories	See section 2 for more information
CWA (Clean Water Act)	Not applicable
Clean Air Act	Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA	Not applicable
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
1,3,5-Trimethylbenzene	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	Moderate risk, Grade 2

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Creation Date	26-Sep-2009
Revision Date	26-Jan-2018
Print Date	26-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

End of SDS

Safety Data Sheet

Prepared in accordance with Commission Regulation (EU) 2015/830

Stock Number:	31275
Revision Date:	24-04-2018
This document replaces SDS dated:	06-01-2017
2 Letter ISO country code/language code:	UK/EN

Chrysene Standard

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

1.1 Product identifier:	**Chrysene Standard**
Stock Number:	31275

Other means of identification:

Synonyms:	None Known
REACH Registration No.:	None Known

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

Relevant identified uses:	For Laboratory use only
Uses advised against:	Uses other than recommended use.

1.3 Details of the Supplier of the Safety Data Sheet:	**Manufacturer**	**Supplier**
	Restek Corporation 110 Benner Circle Bellefonte, Pa. 16823 USA 00 1 814-353-1300 00 1 814-353-1309 sds@restek.com	Thames Restek UK LTD Units 8-16, Ministry Wharf Wycombe Road, Saunderton Buckinghamshire United Kingdom HP14 4HW 01494 563377 sales@thamesrestek.co.uk
1.4 Emergency telephone number:	00 1 800-424-9300 (CHEMTREC within the US)	0870-8200418 (CHEMTREC within the UK)
	00 1 703-741-5970 (Outside USA)	+1 703-741-5970 (CHEMTREC International)
Poison Centre contact information:	National Poisons Information Service (NPIS) Email: director.birmingham.unit@npis.org Website: http://www.npis.org/	

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture:

Classification according to Regulation (EC) No 1272/2008 [CLP]:	Carcinogenicity Category 1B Flammable Liquid Category 2 Serious Eye Damage/Eye Irritation Category 2

Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

2.2 Label elements:

Labelling according to Regulation (EC) No 1272/2008 [CLP]:

Hazard pictograms:

Signal Word: Danger

Hazard Statements:
H225 - Highly flammable liquid and vapour
H319 - Causes serious eye irritation
H336 - May cause drowsiness or dizziness
H350 - May cause cancer.

Precautionary Statements:
P201 - Obtain special instructions before use.

P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

P280 - Wear protective gloves/protective clothing/eye protection/face protection.

P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.

P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Supplemental Hazard information (EU): None Known

2.3 Other hazards: This substance does not meet the PBT or vPvB criteria of REACH, Annex XIII

SECTION 3: Composition/information on ingredients

3.1 Substances:
Not applicable

3.2 Mixtures:

Chemical Name	**%**	**CAS #**	**EC No. REACH Registration No.**	**Classification (EC) No 1272/2008**	**M Factor**	**SCL**	**Acute Toxicity Estimates**
chrysene	0.1	218-01-9	205-923-4 None Known	Aquatic Acute 1; H400 Aquatic Chronic 1; H410 Carc. 1B; H350 Muta. 2; H341	No data available	No data available	Not determined
Acetone	99.9	67-64-1	200-662-2 None Known	Eye Irrit. 2; H319 Flam. Liq. 2; H225 STOT SE 3; H336 EUH066	No data available	No data available	Not determined

For full text of H-statements see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures:

Inhalation:	Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately
Eye contact:	Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.
Skin Contact:	Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.
Ingestion:	Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.
Self protection of the first aider:	No data available
4.2 Most important symptoms and effects, both acute and delayed:	Causes serious eye irritation May cause drowsiness or dizziness
4.3 Indication of any immediate medical attention and special treatment needed:	No additional first aid information available

SECTION 5: Firefighting measures

5.1 Extinguishing media:

Suitable extinguishing media:	Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.
Unsuitable extinguishing media:	None Known
5.2 Special hazards arising from the substance or mixture:	Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a Class B fire. Vapors are heavier than air and may travel to a source of ignition and flash back
Hazardous Combustion Products:	Carbon dioxide, Carbon monoxide
5.3 Advice for firefighters:	Do not enter fire area without proper protection including self-contained toxic breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface. Use water spray/fog for cooling. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Non-emergency personnel:	Non-emergency personnel should be kept clear of the area
Emergency responders:	Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section 8 of this SDS. Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill.
6.2 Environmental precautions:	No data available
6.3 Methods and material for containment and cleaning up:	
Small spills:	Refer to information provided for large spills
Large spills:	Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike

with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.

6.4 Reference to other sections: Refer to section 13 for disposal information

SECTION 7: Handling and storage

7.1 Precautions for safe handling: Harmful or irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment

7.2 Conditions for safe storage, including any incompatibilities:

Conditions for safe storage: Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition

Materials to Avoid/Chemical Incompatibility: Strong oxidizing agents, Strong acids

7.3 Specific end use(s): For Laboratory use only

SECTION 8: Exposure controls/personal protection

8.1 Control parameters:

Occupational Exposure limit values:

Chemical Name	United Kingdom - Workplace Exposure Limits (WELs) - TWAs	United Kingdom - Workplace Exposure Limits (WELs) - STELs	United Kingdom - Biological Monitoring Guidance Values
Acetone	500 ppm TWA; 1210 mg/m3 TWA	1500 ppm STEL; 3620 mg/m3 STEL	No data available

DNEL: None Known

PNEC: None Known

8.2 Exposure controls:

Appropriate engineering controls: Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.

Individual protection measures, such as personal protective equipment:

Eye and face protection: Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.

Skin Protection:

Hand protection: Nitrile Neoprene

Other skin protection: Wear protective gloves. Inspect gloves for chemical break-through and

	replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Respiratory Protection:	No respiratory protection required under normal conditions of use. Provide general room exhaust ventilation if symptoms of overexposure occur as explained Section 3. A respirator is not normally required.
Respirator Type(s):	Not normally required.
Thermal Hazards:	Not applicable
Environmental exposure controls:	No data available

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Appearance:	No data available
Colour:	Depends upon product selection
Odour:	Strong
Odour threshold:	ND
pH:	Not applicable
Melting Point/Freezing Point (°C):	
Melting point (°C):	-95
Freezing point (°C):	No data available
Initial boiling point and boiling range (°C):	56
Flash point (°C):	-20
Evaporation Rate (water = 1):	No data available
Flammability (solid, gas):	No data available
Upper/lower flammability or explosive limits:	
Upper flammable or explosive limit, % in air:	No data available
Lower flammable or explosive limit, % in air:	No data available
Vapour pressure:	No data available
Vapor Density (Air=1):	2
Relative density (water = 1):	0.791
Solubility(ies):	Complete; 100%

Partition coefficient: n-octanol/water:	No data available
Auto-ignition temperature (°C):	465
Decomposition temperature (°C):	No data available
Viscosity:	No data available
Explosive properties:	No data available
Oxidizing properties:	No data available

9.2 Other information:

Volatile Organic Chemicals:	0
Bulk density:	6.601

SECTION 10: Stability and reactivity

10.1 Reactivity:	Not expected to be reactive
10.2 Chemical stability:	Stable under normal conditions.
10.3 Possibility of hazardous reactions:	None expected under standard conditions of storage
10.4 Conditions to avoid:	No data available
10.5 Incompatible materials:	Strong oxidizing agents, Strong acids
10.6 Hazardous decomposition products:	Carbon dioxide, Carbon monoxide

SECTION 11: Toxicological information

11.1 Information on toxicological effects:

Acute toxicity:

Chemical Name	ORAL LD50 (rat)	DERMAL LD50 (rabbit)	INHALATION LC50 (rat)
Acetone	ORAL LD50 Rat 5800 mg/kg	DERMAL LD50 Rabbit > 15700 mg/kg	INHALATION LC50-8H Rat 50100 MG/M3

Based on available data, the classification criteria are not met.

Skin corrosion/irritation:
Based on available data, the classification criteria are not met.

Serious eye damage/irritation:

pH	Not applicable

Classification is based on pH and the components listed in Section 3.

Respiratory or skin sensitisation:
Based on available data, the classification criteria are not met.

Germ cell mutagenicity:
Based on available data, the classification criteria are not met.

Carcinogenicity:
Classification has been based on toxicological information of the components in Section 3.

Reproductive toxicity:
Based on available data, the classification criteria are not met.

STOT-single exposure:
Classification has been based on toxicological information of the components in Section 3.

STOT-repeated exposure:
Based on available data, the classification criteria are not met.

Aspiration hazard:
Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1 Toxicity: This material is not expected to be harmful to the ecology.

Ecological Toxicity Data:

Chemical Name	CAS #	Aquatic EC50 Crustacea	Aquatic ERC50 Algae	Aquatic LC50 Fish
No data available				

12.2 Persistence and degradability:	No data No data
12.3 Bioaccumulative potential:	No data
12.4 Mobility in soil:	No data
12.5 Results of PBT and vPvB assessment:	No data available
12.6 Other adverse effects:	None Known
12.7 Additional information:	No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods:

Disposal methods:	Spent or discarded material is a hazardous waste. Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste codes / waste designations according to LoW:	No data available

SECTION 14: Transport information

International carriage of dangerous goods by road (ADR), rail or inland waterways:

14.1 UN number:	UN1090
14.2 UN proper shipping name:	Acetone
14.3 Transport hazard class(es):	3
14.4 Packing group:	II

International carriage of dangerous goods by air (IATA):

14.1 UN number:	UN1090
14.2 UN proper shipping name:	Acetone
14.3 Transport hazard class(es):	3
14.4 Packing group:	II

14.5 Environmental hazards:	No
14.6 Special precautions for user:	No data available
14.7 Transport in bulk according to Annex II of MARPOL and the IBC Code:	No data available

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

Chemical Name	EINECS	SVHC
Acetone	Yes	No
chrysene	Yes	No

15.2 Chemical Safety Assessment No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

SECTION 16: Other information

Revision Date:	24-04-2018
Indication of changes:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
Abbreviations and acronyms:	CAS = Chemical Abstract Service DNEL= Derivative No Effect Level EC= European Community EINECS = European Inventory of Existing Chemical Substances MSHA = Mine Safety Health Administration NIOSH = National Institute of Occupational Safety & Health OEL = Occupational Exposure Limit PBT= Persistent, Bioaccumulative, Toxic PNEC= Predicted No Effect Concentration SCOEL= Scientific Committee on Occupational Exposure Limits TLV = Threshold Limit Value TWA= Time Weighted Average vPvB= Very Persistent, Very Bioaccumulative Wt.% = Weight Percent
Key literature references and sources for data:	No data available
Hazard phrase(s) referenced in section 3	H341 - Suspected of causing genetic defects. H350 - May cause cancer. H225 - Highly flammable liquid and vapour H319 - Causes serious eye irritation H336 - May cause drowsiness or dizziness H410 - Very toxic to aquatic life with long lasting effects
Precautionary Statements:	
Prevention:	P201 - Obtain special instructions before use. P202 - Do not handle until all safety precautions have been read and understood. P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. 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.

P261 - Avoid breathing dust/fume/gas/mist/vapours/spray.

P264 - Wash thoroughly after handling.

P271 - Use only outdoors or in a well-ventilated area.

P280 - Wear protective gloves/protective clothing/eye protection/face protection.

Response: P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.

P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P308+P313 - IF exposed or concerned: Get medical advice/ attention.

P312 - Call a POISON CENTER/doctor if you feel unwell.

P337+P313 - If eye irritation persists: Get medical advice/attention.

P370+P378 - In case of fire: Use an appropriate extinguisher (see section 5) to extinguish.

Storage: 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.

Disposal: P501 - Dispose of contents/container to a suitable disposal site in accordance with local/national/international regulations.

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

Safety Data Sheet

Revision Date: 08/13/18
www.restek.com

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

1. IDENTIFICATION

Catalog Number / Product Name:	**31272 / Benzo(b)fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	10
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Carcinogenicity Category 1B
Flammable Liquid Category 2
Serious Eye Damage/Eye Irritation Category 2
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Causes serious eye irritation.
May cause drowsiness or dizziness.
May cause cancer.

GHS Precautions:

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

First Aid Measures:
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
IF exposed or concerned: Get medical advice/attention.
Call a POISON CENTER or doctor/physician if you feel unwell.
If eye irritation persists: Get medical advice/attention.
In case of fire: Use extinguishing media in section 5 for extinction.

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

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

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

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.9
benzo (b) fluoranthene	205-99-2	205-911-9	0.1

4. FIRST-AID MEASURES

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

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

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

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

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

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

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

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

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

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

evaluation.

7. HANDLING AND STORAGE

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

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	**CAS No.**	**IDLH**	**ACGIH STEL**	**ACGIH TLV-TWA**	**OSHA Exposure Limit**
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL; 1782 mg/m3 STEL	500 ppm TWA; 1188 mg/m3 TWA	1000 ppm TWA; 2400 mg/m3 TWA
benzo (b) fluoranthene	205-99-2	Not established	None Known	Not established	No data available

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	No respiratory protection required under normal conditions of use. Provide general room exhaust ventilation if symptoms of overexposure occur as explained Section 3. A respirator is not normally required.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Medical Conditions Aggravated By Exposure:	Respiratory disease including asthma and bronchitis

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.0 (air = 1)
Boiling Point (°C):	56.05 °C at 1013.25 hPa
Melting Point (°C):	-95.4 °C Melting Point
Flash Point (°F):	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	465 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	0
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

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

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Respiratory Tract, Skin
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Can cause minor skin irritation, defatting, and dermatitis.
Eye Contact:	Can cause minor irritation, tearing and reddening.
Ingestion Irritation:	May be harmful if swallowed.
Ingestion Toxicity:	Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Upon prolonged or repeated contact, can cause minor skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Dermal LD50 Rabbit >15700 mg/kg; Inhalation LC50 Rat 50100 mg/m3 8 h; Oral LD50 Rat 5800 mg/kg

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.	
Benzo(b)fluoranthene	205-99-2	Present

ACGIH:

Chemical Name	CAS No.	
Benzo[b]fluoranthene	205-99-2	A2 - Suspected Human Carcinogen
Acetone	67-64-1	A4 - Not Classifiable as a Human Carcinogen

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	205-99-2	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	This material is not expected to be harmful to the ecology.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	No data
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.

Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

Marine Pollutant: No

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

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
Acetone	67-64-1	X	-	-	X
benzo (b) fluoranthene	205-99-2	X	X	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Benzo[b]fluoranthene	205-99-2	Prop 65 Cancer

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
Acetone	67-64-1	X	X	X	X
benzo (b) fluoranthene	205-99-2	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	12/08/16
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 4.7
Revision Date 12/28/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : **Lead**

Product Number : 695912
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
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 # : (314) 776-6555

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
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (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 or doctor/ physician 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

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : Pb
Molecular weight : 207.20 g/mol
CAS-No. : 7439-92-1
EC-No. : 231-100-4

Hazardous components

Component	Classification	Concentration
Lead		
	Acute Tox. 4; Carc. 2; Repr. 2; STOT RE 2; Aquatic Acute 1; Aquatic Chronic 1; H302, H351, H361, H373, H410	<= 100 %

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

4. FIRST AID MEASURES

4.1 Description of first aid measures

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

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

In case of skin contact
Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
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

Lead oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

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.

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): 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

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/m3	USA. ACGIH Threshold Limit Values (TLV)
		Confirmed animal carcinogen with unknown relevance to humans		
		TWA	0.05 mg/m3	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/m3	USA. NIOSH Recommended Exposure Limits
		See Appendix C		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Lead	7439-92-1	Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			
		Lead	30µg/ 100 ml	In blood	ACGIH - Biological Exposure Indices (BEI)
		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.

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

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
In the event of fire: see section 5

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:	Reasonably anticipated to be a human carcinogen (Lead)
	Reasonably anticipated to be a human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Lead)
OSHA:	1910.1025 (Lead)
	OSHA specifically regulated carcinogen (Lead)

Reproductive toxicity
Suspected human reproductive toxicant

Reproductive toxicity - Rat - Inhalation
Effects on Newborn: Biochemical and metabolic.

Reproductive toxicity - Rat - Oral
Effects on Newborn: Behavioral.

Reproductive toxicity - Mouse - Oral
Effects on Fertility: Female fertility index (e.g., # females pregnant per # sperm positive females; # females pregnant per # females mated). Effects on Fertility: Pre-implantation mortality (e.g., reduction in number of implants per female; total number of implants per corpora lutea).

Developmental Toxicity - Rat - Inhalation
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow).

Developmental Toxicity - Rat - Oral
Specific Developmental Abnormalities: Blood and lymphatic system (including spleen and marrow). Effects on Newborn: Growth statistics (e.g., reduced weight gain).

Developmental Toxicity - Rat - Oral
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Developmental Toxicity - Mouse - Oral
Effects on Embryo or Fetus: Fetotoxicity (except death, e.g., stunted fetus). Effects on Embryo or Fetus: Fetal death.

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
May cause damage to organs through prolonged or repeated exposure.

Aspiration hazard
No data available

Additional Information
RTECS: OF7525000

anemia

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	mortality LOEC - Oncorhynchus mykiss (rainbow trout) - 1.19 mg/l - 96.0 h
	LC50 - Micropterus dolomieui - 2.2 mg/l - 96.0 h
	mortality NOEC - Salvelinus fontinalis - 1.7 mg/l - 10.0 d
Toxicity to daphnia and other aquatic invertebrates	mortality LOEC - Daphnia (water flea) - 0.17 mg/l - 24 h
	mortality NOEC - Daphnia (water flea) - 0.099 mg/l - 24 h
Toxicity to algae	mortality EC50 - Skeletonema costatum - 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 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.

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.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substances, 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.

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	1994-04-01

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Lead	7439-92-1	1994-04-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Lead	7439-92-1	1989-07-10
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Lead	7439-92-1	1989-07-10

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
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.

H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard: 1
Chronic Health Hazard: *
Flammability: 0
Physical Hazard 0

NFPA Rating

Health hazard: 1
Fire Hazard: 0
Reactivity Hazard: 0

Further information

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

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 12/28/2015 Print Date: 05/01/2016

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 3.12
Revision Date 12/02/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Mercury

Product Number : 215457
Brand : Sigma-Aldrich
Index-No. : 080-001-00-0

CAS-No. : 7439-97-6

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 # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Inhalation (Category 2), H330
Reproductive toxicity (Category 1B), H360
Specific target organ toxicity - repeated exposure (Category 1), H372
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (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 Danger

Hazard statement(s)	
H330	Fatal if inhaled.
H360	May damage fertility or the unborn child.
H372	Causes 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.
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.
P284	Wear respiratory protection.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
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

Formula : Hg
Molecular weight : 200.59 g/mol
CAS-No. : 7439-97-6
EC-No. : 231-106-7
Index-No. : 080-001-00-0

Hazardous components

Component	Classification	Concentration
Mercury		
	Acute Tox. 2; Repr. 1B; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H330, H360, H372, H410	<= 100 %

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

---

4. FIRST AID MEASURES

4.1 Description of first aid measures

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

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

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

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

Mercury/mercury oxides.

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe 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

Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal. In some instances, a mercury spill kit may be used. Please consult with your site EHS representative to determine the most appropriate clean up method.Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
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 under inert gas.
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

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
Mercury	7439-97-6	C	0.1 mg/m3	USA. NIOSH Recommended Exposure Limits
	Remarks	Potential for dermal absorption		

		CEIL	1.0mg/10m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		TWA	0.05 mg/m3	USA. OSHA - TABLE Z-1 Limits for Air Contaminants - 1910.1000
		Skin notation		
		TWA	0.025 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Central Nervous System impairment Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Not classifiable as a human carcinogen Danger of cutaneous absorption		
		TWA	0.05 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Mercury	7439-97-6	Mercury	0.0400 mg/g	In urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Prior to shift (16 hours after exposure ceases)			
		Mercury	15.0000 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		End of shift at end of workweek			

8.2 Exposure controls

Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection

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

Skin protection

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

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

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

---

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: silver, white
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: -38.87 °C (-37.97 °F) - lit.
f)	Initial boiling point and boiling range	356.6 °C (673.9 °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	< 0.01 hPa (< 0.01 mmHg) at 20 °C (68 °F) 1 hPa (1 mmHg) at 126 °C (259 °F)
l)	Vapour density	6.93 - (Air = 1.0)
m)	Relative density	13.55 g/cm3 at 25 °C (77 °F)
n)	Water solubility	0.00006 g/l at 25 °C (77 °F)
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

Relative vapour density	6.93 - (Air = 1.0)

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 oxidizing agents, Ammonia, Azides, Nitrates, Chlorates, Copper

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

LC50 Inhalation - Rat - male - 2 h - < 27 mg/m3

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
No data available

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification.

IARC:	3 - Group 3: Not classifiable as to its carcinogenicity to humans (Mercury)
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
Presumed human reproductive toxicant

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: OV4550000

Mercury accumulates in almost all tissues, especially in the:, Kidney, Effects due to ingestion may include:, Nausea, Vomiting, Diarrhoea, intestinal bleeding

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	mortality LC50 - Cyprinus carpio (Carp) - 0.160 mg/l - 96 h

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential

Bioaccumulation	Carassius auratus (goldfish) - 1,789 d - 0.25 µg/l Bioconcentration factor (BCF): 155,986

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.

No data available

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.

Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 2809 Class: 8 (6.1) Packing group: III
Proper shipping name: A,W Mercury
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 2809 Class: 8 (6.1) Packing group: III EMS-No: F-A, S-B
Proper shipping name: MERCURY
Marine pollutant:yes

IATA
UN number: 2809 Class: 8 (6.1) Packing group: III
Proper shipping name: Mercury

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

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Mercury	7439-97-6	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. Mercury	7439-97-6	2013-12-20

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H330	Fatal if inhaled.
H360	May damage fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
Repr.	Reproductive toxicity

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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

Preparation Information
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 3.12 Revision Date: 12/02/2015 Print Date: 05/01/2016

SAFETY DATA SHEET

Version 4.7
Revision Date 05/23/2016
Print Date 06/23/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name	:	Arsenic
Product Number	:	202657
Brand	:	Aldrich
Index-No.	:	033-001-00-X
CAS-No.	:	7440-38-2

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

Identified uses	:	Laboratory chemicals, 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 #	:	(314) 776-6555

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
Acute toxicity, Inhalation (Category 3), H331
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (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	Danger
Hazard statement(s)	
H302	Harmful if swallowed.
H331	Toxic if inhaled.
H410	Very toxic to aquatic life with long lasting effects.
Precautionary statement(s)	
P261	Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
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.

P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
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

Formula : As
Molecular weight : 74.92 g/mol
CAS-No. : 7440-38-2
EC-No. : 231-148-6
Index-No. : 033-001-00-X

Hazardous components

Component	Classification	Concentration
Arsenic		
	Acute Tox. 4; Acute Tox. 3; Aquatic Acute 1; Aquatic Chronic 1; H302, H331, H410	<= 100 %

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

4. FIRST AID MEASURES

4.1 Description of first aid measures

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

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

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

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

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. 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.

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): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

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
Arsenic	7440-38-2	TWA	0.01 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Lung cancer Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Confirmed human carcinogen		
		C	0.0020 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A 15 minute ceiling value		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Arsenic	7440-38-2	inorganic arsenic plus methylated metabolites	35µg As/l	In urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of the workweek (After four or five consecutive working days			

		with exposure)			
		inorganic arsenic plus methylated metabolites	35µg As/l	Urine	ACGIH - Biological Exposure Indices (BEI)
		End of the workweek (After four or five consecutive working days with exposure)			

8.2 Exposure controls

Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection

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

Skin protection

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

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 N99 (US) or type P2 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

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: Pieces Colour: grey
b)	Odour	No data available
c)	Odour Threshold	No data available

d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 817 °C (1,503 °F) - lit.
f)	Initial boiling point and boiling range	613 °C (1,135 °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	5.727 g/mL at 25 °C (77 °F)
n)	Water solubility	No data available
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

No data available

---

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

Heat Exposure to air may affect product quality.

10.5 Incompatible materials

Oxidizing agents, Halogens, Palladium undergoes a violent reaction with arsenic, Zinc, Platinum oxide, Nitrogen trichloride, Bromine azide

10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Arsenic oxides
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 763 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

LD50 Oral - Mouse - 145 mg/kg
Remarks: Behavioral:Ataxia. Diarrhoea

Inhalation: No data available

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
No data available

Carcinogenicity

This is or contains a component that has been reported to be carcinogenic based on its IARC, OSHA, ACGIH, NTP, or EPA classification.

IARC:	1 - Group 1: Carcinogenic to humans (Arsenic)
NTP:	Known to be human carcinogen (Arsenic)
	Known to be human carcinogen (Arsenic)
OSHA:	OSHA specifically regulated carcinogen (Arsenic)

Reproductive toxicity
No data available

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: CG0525000

Absorption into the body leads to the formation of methemoglobin which in sufficient concentration causes cyanosis. Onset may be delayed 2 to 4 hours or longer.

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 9.9 mg/l - 96.0 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 3.8 mg/l - 48 h

12.2 Persistence and degradability

No data available

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

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.

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.

14. TRANSPORT INFORMATION

DOT (US)

UN number: 1558 Class: 6.1 Packing group: II
Proper shipping name: Arsenic
Reportable Quantity (RQ): 1 lbs

Poison Inhalation Hazard: No

IMDG

UN number: 1558 Class: 6.1 Packing group: II EMS-No: F-A, S-A
Proper shipping name: ARSENIC
Marine pollutant:yes

IATA

UN number: 1558 Class: 6.1 Packing group: II
Proper shipping name: Arsenic

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
Arsenic	7440-38-2	2007-07-01

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Arsenic	7440-38-2	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Arsenic	7440-38-2	2008-10-10

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H302	Harmful if swallowed.
H331	Toxic if inhaled.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	2
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	2
Fire Hazard:	0
Reactivity Hazard:	0

Further information

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 05/23/2016 Print Date: 06/23/2016

SAFETY DATA SHEET

Version 4.7
Revision Date 12/28/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Nickel

Product Number : 268259
Brand : Aldrich
Index-No. : 028-002-00-7

CAS-No. : 7440-02-0

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 # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Skin sensitisation (Category 1), H317
Carcinogenicity (Category 2), H351
Specific target organ toxicity - repeated exposure, Inhalation (Category 1), H372
Acute aquatic toxicity (Category 3), H402
Chronic aquatic toxicity (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)	
H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if inhaled.
H412	Harmful 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.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P333 + P313	If skin irritation or rash occurs: Get medical advice/ attention.
P363	Wash contaminated clothing before reuse.
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

Formula : Ni
Molecular weight : 58.69 g/mol
CAS-No. : 7440-02-0
EC-No. : 231-111-4
Index-No. : 028-002-00-7

Hazardous components

Component	Classification	Concentration
Nickel		
	Skin Sens. 1; Carc. 2; STOT RE 1; Aquatic Acute 3; Aquatic Chronic 3; H317, H351, H372, H412	<= 100 %

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

4. FIRST AID MEASURES

4.1 Description of first aid measures

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

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

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

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

Nickel/nickel oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

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.

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.Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
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): 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

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Nickel	7440-02-0	TWA	1.500000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Dermatitis Pneumoconiosis Not suspected as a human carcinogen		
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		

		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015000 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		TWA	1.5 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Dermatitis Pneumoconiosis Not suspected as a human carcinogen		
		TWA	1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.015 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		

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.

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.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Foil Colour: white, silver, metallic
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 1,453 °C (2,647 °F) - lit.
f)	Initial boiling point and boiling range	2,732 °C (4,950 °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	1 hPa (1 mmHg) at 1,810 °C (3,290 °F)
l)	Vapour density	No data available
m)	Relative density	8.9 g/mL at 25 °C (77 °F)
n)	Water solubility	insoluble
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

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

acids, Oxidizing agents, Sulphur compounds, Hydrogen gas, Oxygen, Methanol, organic solvents, Aluminium, Fluorine, Ammonia

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

---

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
May cause sensitisation by skin contact.

Germ cell mutagenicity
No data available

Carcinogenicity

Limited evidence of carcinogenicity in animal studies

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Nickel)
1 - Group 1: Carcinogenic to humans (Nickel)
2B - Group 2B: Possibly carcinogenic to humans (Nickel)

IARC: 2B - Group 2B: Possibly carcinogenic to humans (Nickel)
1 - Group 1: Carcinogenic to humans (Nickel)
2B - Group 2B: Possibly carcinogenic to humans (Nickel)

NTP: Reasonably anticipated to be a human carcinogen (Nickel)
Reasonably anticipated to be a human carcinogen (Nickel)

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

Reproductive toxicity
No data available

No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
Inhalation - Causes damage to organs through prolonged or repeated exposure.

Aspiration hazard
No data available

Additional Information
RTECS: QR5950000

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Cyprinus carpio (Carp) - 1.3 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 1 mg/l - 48 h

12.2 Persistence and degradability
Not applicable

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.

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.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

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
Nickel	7440-02-0	2007-07-01

SARA 311/312 Hazards
Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Nickel	7440-02-0	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Nickel	7440-02-0	2007-09-28

---

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H317	May cause an allergic skin reaction.
H351	Suspected of causing cancer.
H372	Causes damage to organs through prolonged or repeated exposure if inhaled.
H402	Harmful to aquatic life.
H412	Harmful to aquatic life with long lasting effects.

HMIS Rating
Health hazard: 2
Chronic Health Hazard: *
Flammability: 0
Physical Hazard 0

NFPA Rating
Health hazard: 2
Fire Hazard: 0
Reactivity Hazard: 0

Further information

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

Preparation Information
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 12/28/2015 Print Date: 05/01/2016

SAFETY DATA SHEET
Calcium Standard

Revision: 04/16/2015
Supersedes Revision: 06/09/2011

according to Regulation (EC) No. 1907/2006 as amended by (EC) No. 1272/2008

Section 1. Identification of the Substance/Mixture and of the Company/Undertaking

1.1	**Product Code:**	700552	
	Product Name:	Calcium Standard	

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

Relevant identified uses: For research use only, not for human or veterinary use.

1.3 Details of the Supplier of the Safety Data Sheet:

Company Name:
Cayman Chemical Company
1180 E. Ellsworth Rd.
Ann Arbor, MI 48108

Web site address: www.caymanchem.com

Information: Cayman Chemical Company +1 (734)971-3335

1.4 Emergency telephone number:

Emergency Contact:	CHEMTREC Within USA and Canada:	+1 (800)424-9300
	CHEMTREC Outside USA and Canada:	+1 (703)527-3887

Section 2. Hazards Identification

2.1 Classification of the Substance or Mixture:

2.1.1 Classification according to Regulation (EC) No 1272/2008 [CLP]:

Skin Corrosion/Irritation, Category 3

2.2 Label Elements:

2.2.1 Labeling according to Regulation (EC) No 1272/2008 [CLP]:

GHS Signal Word: **Warning**

GHS Hazard Phrases:

H316: Causes mild skin irritation.

GHS Precaution Phrases:

No phrases apply.

GHS Response Phrases:

P332+313: If skin irritation occurs, get medical advice/attention.

GHS Storage and Disposal Phrases:

Please refer to Section 7 for Storage and Section 13 for Disposal information.

2.3 Adverse Human Health Effects and Symptoms:

Causes mild skin irritation.
Material may be irritating to the mucous membranes and upper respiratory tract.
May be harmful by inhalation, ingestion, or skin absorption.
May cause eye or respiratory system irritation.
To the best of our knowledge, the toxicological properties have not been thoroughly investigated.

Section 3. Composition/Information on Ingredients

CAS # / RTECS #	Hazardous Components (Chemical Name)/ REACH Registration No.	Concentration	EC No./ EC Index No.	GHS Classification
471-34-1 FF9335000	Calcium carbonate	2.0 %	207-439-9 NA	No data available.
77-86-1 TY2900000	Trizma base	1.21 %	201-064-4 NA	Skin Corr. 2: H315 Eye Damage 2: H319 STOT (SE) 3: H335 H336
7732-18-5	Water	96.79 %	231-791-2	No data available.

ZC0110000			NA	

Section 4. First Aid Measures

4.1	**Description of First Aid Measures:**	No data available.
	In Case of Inhalation:	Remove to fresh air. If not breathing, give artificial respiration or give oxygen by trained personnel. Get immediate medical attention.
	In Case of Skin Contact:	Immediately wash skin with soap and plenty of water for at least 15 minutes. Remove contaminated clothing. Get medical attention if symptoms occur. Wash clothing before reuse.
	In Case of Eye Contact:	Hold eyelids apart and flush eyes with plenty of water for at least 15 minutes. Have eyes examined and tested by medical personnel.
	In Case of Ingestion:	Wash out mouth with water provided person is conscious. Never give anything by mouth to an unconscious person. Get medical attention. Do NOT induce vomiting unless directed to do so by medical personnel.

Section 5. Fire Fighting Measures

5.1	**Suitable Extinguishing Media:**	Use alcohol-resistant foam, carbon dioxide, water, or dry chemical spray. Use water spray to cool fire-exposed containers.	
	Unsuitable Extinguishing Media:	A solid water stream may be inefficient.	
5.2	**Flammable Properties and Hazards:**	No data available.	
	Flash Pt:	No data.	
	Explosive Limits:	LEL: No data.	UEL: No data.
	Autoignition Pt:	No data.	
5.3	**Fire Fighting Instructions:**	As in any fire, wear self-contained breathing apparatus pressure-demand (NIOSH approved or equivalent), and full protective gear to prevent contact with skin and eyes.	

Section 6. Accidental Release Measures

6.1	**Protective Precautions, Protective Equipment and Emergency Procedures:**	Avoid breathing vapors and provide adequate ventilation. As conditions warrant, wear a NIOSH approved self-contained breathing apparatus, or respirator, and appropriate personal protection (rubber boots, safety goggles, and heavy rubber gloves).
6.2	**Environmental Precautions:**	Take steps to avoid release into the environment, if safe to do so.
6.3	**Methods and Material For Containment and Cleaning Up:**	Contain spill and collect, as appropriate. Transfer to a chemical waste container for disposal in accordance with local regulations.

Section 7. Handling and Storage

7.1	**Precautions To Be Taken in Handling:**	Avoid breathing dust/fume/gas/mist/vapours/spray. Avoid prolonged or repeated exposure.
7.2	**Precautions To Be Taken in Storing:**	Keep container tightly closed. Store in accordance with information listed on the product insert.

Section 8. Exposure Controls/Personal Protection

8.1 Exposure Parameters:

CAS #	Partial Chemical Name	Britain EH40	France VL	Europe
471-34-1	Calcium carbonate	No data.	TWA: 10 mg/m3	No data.
77-86-1	Trizma base	No data.	No data.	No data.
7732-18-5	Water	No data.	No data.	No data.

CAS #	Partial Chemical Name	OSHA TWA	ACGIH TWA	Other Limits
471-34-1	Calcium carbonate	No data.	TLV: 10 mg/m3 (E)	No data.
77-86-1	Trizma base	No data.	No data.	No data.
7732-18-5	Water	No data.	No data.	No data.

8.2 Exposure Controls:

8.2.1 Engineering Controls (Ventilation etc.): Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

8.2.2 Personal protection equipment:

Eye Protection:	Safety glasses
Protective Gloves:	Compatible chemical-resistant gloves
Other Protective Clothing:	Lab coat
Respiratory Equipment (Specify Type):	NIOSH approved respirator, as conditions warrant.
Work/Hygienic/Maintenance Practices:	Do not take internally. Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Wash thoroughly after handling. No data available.

Section 9. Physical and Chemical Properties

9.1 Information on Basic Physical and Chemical Properties

Physical States:	[ ] Gas [X] Liquid [ ] Solid	
Appearance and Odor:	Solution	
pH:	7.0	
Melting Point:	No data.	
Boiling Point:	No data.	
Flash Pt:	No data.	
Evaporation Rate:	No data.	
Explosive Limits:	LEL: No data.	UEL: No data.
Vapor Pressure (vs. Air or mm Hg):	No data.	
Vapor Density (vs. Air = 1):	No data.	
Specific Gravity (Water = 1):	No data.	
Solubility in Water:	No data.	
Autoignition Pt:	No data.	

9.2 Other Information

Percent Volatile: No data.

Section 10. Stability and Reactivity

10.1 Reactivity: No data available.

10.2 Stability: Unstable [ ] Stable [X]

10.3 Stability Note(s): Stable if stored in accordance with information listed on the product insert.

Polymerization: Will occur [ ] Will not occur [X]

10.4 Conditions To Avoid: No data available.

10.5 Incompatibility - Materials To Avoid: No data available.

10.6 Hazardous Decomposition Or Byproducts: No data available.

Section 11. Toxicological Information

11.1 Information on Toxicological Effects: The toxicological effects of this product have not been thoroughly studied.

Carcinogenicity: NTP? No IARC Monographs? No OSHA Regulated? No

CAS #	Hazardous Components (Chemical Name)	NTP	IARC	ACGIH	OSHA
471-34-1	Calcium carbonate	n.a.	n.a.	n.a.	n.a.
77-86-1	Trizma base	n.a.	n.a.	n.a.	n.a.
7732-18-5	Water	n.a.	n.a.	n.a.	n.a.

Section 12. Ecological Information

12.1 Toxicity: Avoid release into the environment.
Runoff from fire control or dilution water may cause pollution.

12.2 Persistence and Degradability: No data available.

12.3 Bioaccumulative Potential: No data available.

12.4 Mobility in Soil: No data available.

12.5 Results of PBT and vPvB assessment: No data available.

12.6 Other adverse effects: No data available.

Section 13. Disposal Considerations

13.1 Waste Disposal Method: Dispose in accordance with local, state, and federal regulations.

Section 14. Transport Information

14.1 LAND TRANSPORT (US DOT):

DOT Proper Shipping Name: Not dangerous goods.

DOT Hazard Class:

UN/NA Number:

14.1 LAND TRANSPORT (European ADR/RID):

ADR/RID Shipping Name: Not dangerous goods.

UN Number:

Hazard Class:

14.3 AIR TRANSPORT (ICAO/IATA):

ICAO/IATA Shipping Name: Not dangerous goods.

Additional Transport Information: Transport in accordance with local, state, and federal regulations.

Section 15. Regulatory Information

EPA SARA (Superfund Amendments and Reauthorization Act of 1986) Lists

CAS #	Hazardous Components (Chemical Name)	S. 302 (EHS)	S. 304 RQ	S. 313 (TRI)
471-34-1	Calcium carbonate	No	No	No
77-86-1	Trizma base	No	No	Yes-Cat. N106
7732-18-5	Water	No	No	No

CAS #	Hazardous Components (Chemical Name)	Other US EPA or State Lists
471-34-1	Calcium carbonate	CAA HAP,ODC: No; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No
77-86-1	Trizma base	CAA HAP,ODC: HAP; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No
7732-18-5	Water	CAA HAP,ODC: No; CWA NPDES: No; TSCA: Yes - Inventory; CA PROP.65: No

Regulatory Information Statement: This SDS was prepared in accordance with 29 CFR 1910.1200 and Regulation (EC) No.1272/2008.

Section 16. Other Information

Revision Date: 04/16/2015

Additional Information About This Product: No data available.

Company Policy or Disclaimer: DISCLAIMER: This information 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.

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 4.10
Revision Date 12/29/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Cadmium

Product Number : 414891
Brand : Aldrich
Index-No. : 048-002-00-0

CAS-No. : 7440-43-9

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 # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Acute toxicity, Inhalation (Category 2), H330
Germ cell mutagenicity (Category 2), H341
Carcinogenicity (Category 1B), H350
Reproductive toxicity (Category 2), H361
Specific target organ toxicity - repeated exposure (Category 1), H372
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (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 Danger

Hazard statement(s)

H330	Fatal if inhaled.
H341	Suspected of causing genetic defects.
H350	May cause cancer.
H361	Suspected of damaging fertility or the unborn child.
H372	Causes 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.
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.
P284	Wear respiratory protection.
P304 + P340 + P310	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER or doctor/ physician.
P308 + P313	IF exposed or concerned: Get medical advice/ attention.
P391	Collect spillage.
P403 + P233	Store in a well-ventilated place. Keep container tightly closed.
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

Formula : Cd
Molecular weight : 112.41 g/mol
CAS-No. : 7440-43-9
EC-No. : 231-152-8
Index-No. : 048-002-00-0

Hazardous components

Component	Classification	Concentration
Cadmium Included in the Candidate List of Substances of Very High Concern (SVHC) according to Regulation (EC) No. 1907/2006 (REACH)		
	Acute Tox. 2; Muta. 2; Carc. 1B; Repr. 2; STOT RE 1; Aquatic Acute 1; Aquatic Chronic 1; H330, H341, H350, H361, H372, H410	<= 100 %

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

4. FIRST AID MEASURES

4.1 Description of first aid measures

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

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

In case of skin contact
Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

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

Cadmium/cadmium oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear respiratory protection. Avoid dust formation. Avoid breathing 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.

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.

Air sensitive.
Storage class (TRGS 510): Non-combustible, acute toxic Cat. 1 and 2 / very toxic hazardous materials

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
Cadmium	7440-43-9	TWA	0.010000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section)		

		Suspected human carcinogen		
		TWA	0.002000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen		
		Substance listed; for more information see OSHA document 1910.1027		
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.300000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.600000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.300000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		Potential Occupational Carcinogen See Appendix A		
		TWA	0.200000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.600000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		PEL	0.005000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1027 This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Occupational Safety and Health Act, except the construction-related industries, which are covered under 29 CFR 1926.63. OSHA specifically regulated carcinogen		

		Potential Occupational Carcinogen See Appendix A		
		Potential Occupational Carcinogen See Appendix A		
		TWA	0.010000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		
		TWA	0.002000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		
		PEL	0.005000 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1027 This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Occupational Safety and Health Act, except the construction-related industries, which are covered under 29 CFR 1926.63. OSHA specifically regulated carcinogen		
		TWA	0.1 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		TWA	0.2 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.3 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		CEIL	0.6 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-2
		Z37.5-1970 This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.		
		Substance listed; for more information see OSHA document 1910.1027		
		Potential Occupational Carcinogen See Appendix A		
		TWA	0.01 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		

		TWA	0.002 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Kidney damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Suspected human carcinogen varies		
		PEL	0.005 mg/m3	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1027 This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Occupational Safety and Health Act, except the construction-related industries, which are covered under 29 CFR 1926.63. OSHA specifically regulated carcinogen		

Biological occupational exposure limits

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Cadmium	7440-43-9	cadmium	0.0050 mg/g	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	Not critical			
		cadmium	5.0000 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			
		cadmium	5 µg/l	In blood	ACGIH - Biological Exposure Indices (BEI)
		Not critical			
		cadmium	5µg/g creatinine	Urine	ACGIH - Biological Exposure Indices (BEI)
		Not critical			

8.2 Exposure controls

Appropriate engineering controls

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

Personal protective equipment

Eye/face protection

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

Skin protection

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

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.

---

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: granular Colour: light grey
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 320.9 °C (609.6 °F) - lit.
f)	Initial boiling point and boiling range	765 °C (1,409 °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	8.65 g/cm3 at 25 °C (77 °F)
n)	Water solubility	0.0023 g/l at 20 °C (68 °F)
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

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

Oxidizing agents, acids

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - 2,330 mg/kg

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
No data available

Carcinogenicity

IARC:	1 - Group 1: Carcinogenic to humans (Cadmium)
NTP:	Known to be human carcinogenThe reference note has been added by TD based on the background information of the NTP. (Cadmium)
OSHA:	OSHA specifically regulated carcinogen (Cadmium)

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: EU9800000

Damage to the lungs., Kidney injury may occur., prolonged or repeated exposure can cause:, Vomiting, Diarrhoea, Lung irritation

Stomach - Irregularities - Based on Human Evidence
Stomach - Irregularities - Based on Human Evidence

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Pimephales promelas (fathead minnow) - 0.001 mg/l - 96 h
Toxicity to daphnia and other aquatic invertebrates	EC50 - Daphnia magna (Water flea) - 0.024 mg/l - 48 h
Toxicity to algae	static test EC50 - Selenastrum capricornutum (green algae) - 0.023 mg/l - 72 h (OECD Test Guideline 201)

12.2 Persistence and degradability
No data available

12.3 Bioaccumulative potential

Bioaccumulation	Oncorhynchus mykiss (rainbow trout) - 72 d - 1.27 µg/l Bioconcentration factor (BCF): 55

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.

No data available

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.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3288 Class: 6.1 Packing group: II
Proper shipping name: Toxic solid, inorganic, n.o.s. (Cadmium)
Reportable Quantity (RQ): 10 lbs

Poison Inhalation Hazard: No

IMDG
UN number: 3288 Class: 6.1 Packing group: II EMS-No: F-A, S-A
Proper shipping name: TOXIC SOLID, INORGANIC, N.O.S. (Cadmium)
Marine pollutant:yes
IATA
UN number: 3288 Class: 6.1 Packing group: II

Proper shipping name: Toxic solid, inorganic, n.o.s. (Cadmium)

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
Cadmium	7440-43-9	2007-07-01

SARA 311/312 Hazards

Acute Health Hazard, Chronic Health Hazard

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Cadmium	7440-43-9	2007-07-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Cadmium	7440-43-9	2007-07-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Cadmium	7440-43-9	2007-07-01

California Prop. 65 Components

	CAS-No.	Revision Date
WARNING! This product contains a chemical known to the State of California to cause cancer. Cadmium	7440-43-9	2009-02-01
WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Cadmium	7440-43-9	2009-02-01

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

Acute Tox.	Acute toxicity
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
Carc.	Carcinogenicity
H330	Fatal if inhaled.
H341	Suspected of causing genetic defects.
H350	May cause cancer.
H361	Suspected of damaging fertility or the unborn child.
H372	Causes damage to organs through prolonged or repeated exposure.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	4
Chronic Health Hazard:	*
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	4
Fire Hazard:	0

Reactivity Hazard: 0

Further information

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

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.10 Revision Date: 12/29/2015 Print Date: 05/01/2016

SAFETY DATA SHEET

Version 4.7
Revision Date 02/27/2015
Print Date 05/24/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Copper

Product Number : 12816
Brand : Aldrich

CAS-No. : 7440-50-8

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

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
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 # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

2.2 GHS Label elements, including precautionary statements

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

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula : Cu
Molecular weight : 63.55 g/mol
CAS-No. : 7440-50-8
EC-No. : 231-159-6

Hazardous components

Component	Classification	Concentration
Copper		
		<= 100 %

4. FIRST AID MEASURES

4.1 Description of first aid measures

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration.

In case of skin contact
Wash off with soap and plenty of water.

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.

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

Copper oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

---

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Avoid dust formation. Avoid breathing vapours, mist or gas.
For personal protection see section 8.

6.2 Environmental precautions

No special environmental precautions required.

6.3 Methods and materials for containment and cleaning up

Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections

For disposal see section 13.

---

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

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.

Store under inert gas. Air sensitive.
Storage class (TRGS 510): Non Combustible Solids

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
Copper	7440-50-8	TWA	1.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Irritation Gastrointestinal metal fume fever		
		TWA	0.200000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		Irritation Gastrointestinal metal fume fever		
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	1.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	0.100000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

8.2 Exposure controls

Appropriate engineering controls

General industrial hygiene practice.

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.

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

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
No special environmental precautions required.

---

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Foil Colour: light red
b)	Odour	No data available
c)	Odour Threshold	No data available
d)	pH	No data available
e)	Melting point/freezing point	Melting point/range: 1,083.4 °C (1,982.1 °F)
f)	Initial boiling point and boiling range	2,567 °C (4,653 °F)
g)	Flash point	No data available
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	8.940 g/cm3
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

---

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, Strong oxidizing agents, Acid chlorides, Halogens

10.6 Hazardous decomposition products
Other decomposition products - No data available
In the event of fire: see section 5

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available

Inhalation: No data available

Dermal: No data available

LD50 Intraperitoneal - Mouse - 3.5 mg/kg

Skin corrosion/irritation
No data available

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.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
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
No data available

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: GL5325000

Symptoms of systemic copper poisoning may include: capillary damage, headache, cold sweat, weak pulse, and kidney and liver damage, central nervous system excitation followed by depression, jaundice, convulsions, paralysis, and coma. Death may occur from shock or renal failure. Chronic copper poisoning is typified by hepatic cirrhosis, brain damage and demyelination, kidney defects, and copper deposition in the cornea as exemplified by humans with Wilson's disease. It has also been reported that copper poisoning has lead to hemolytic anemia and accelerates arteriosclerosis.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
No data available

12.2 Persistence and degradability

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

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.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

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. (Copper)
Marine pollutant:yes

IATA
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Copper)

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.

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.

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

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Copper	7440-50-8	1989-08-11

New Jersey Right To Know Components

	CAS-No.	Revision Date
Copper	7440-50-8	1989-08-11

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.

16. OTHER INFORMATION

HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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

Preparation Information

Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 4.7 Revision Date: 02/27/2015 Print Date: 05/24/2016

SIGMA-ALDRICH

sigma-aldrich.com

SAFETY DATA SHEET

Version 5.8
Revision Date 10/12/2015
Print Date 05/01/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name : Zinc

Product Number : 96454
Brand : Sigma-Aldrich

CAS-No. : 7440-66-6

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 # : (314) 776-6555

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)
Combustible dust,
Acute aquatic toxicity (Category 1), H400
Chronic aquatic toxicity (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)

	May form combustible dust concentrations in air
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273	Avoid release to the environment.
P391	Collect spillage.
P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Hazards not otherwise classified (HNOC) or not covered by GHS

Combustible dust

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.2 Mixtures

Formula : Zn
Molecular weight : 65.39 g/mol

Hazardous components

Component		Classification	Concentration
Zinc powder (stabilized)			
CAS-No. EC-No. Index-No.	7440-66-6 231-175-3 030-001-01-9	Aquatic Acute 1; Aquatic Chronic 1; H410	<= 100 %
Zinc oxide			
CAS-No. EC-No. Index-No.	1314-13-2 215-222-5 030-013-00-7	Aquatic Acute 1; Aquatic Chronic 1; H410	>= 5 - < 10 %

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

4. FIRST AID MEASURES

4.1 Description of first aid measures

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.

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

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Special powder against metal fire Dry sandUse water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

Unsuitable extinguishing media
Water

5.2 Special hazards arising from the substance or mixture

Zinc/zinc oxides

5.3 Advice for firefighters

Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information

No data available

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.

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.

Keep in a dry place.
Storage class (TRGS 510): Non Combustible Solids

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
Zinc oxide	1314-13-2	TWA	2.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	metal fume fever		
		STEL	10.000000 mg/m3	USA. ACGIH Threshold Limit Values (TLV)
		metal fume fever		

		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		ST	10.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		C	15.000000 mg/m3	USA. NIOSH Recommended Exposure Limits
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	15.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		TWA	5.000000 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants

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.

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

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.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: powder Colour: grey
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	Not applicable
e)	Melting point/freezing point	Melting point/range: 420 °C (788 °F) - lit.
f)	Initial boiling point and boiling range	907 °C (1,665 °F) - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	May form combustible dust concentrations in air
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	Not applicable
l)	Vapour density	No data available
m)	Relative density	7.133 g/mL at 25 °C (77 °F)
n)	Water solubility	insoluble
o)	Partition coefficient: n-octanol/water	Not applicable
p)	Auto-ignition temperature	does not ignite
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	During processing, dust may form explosive mixture in air.
t)	Oxidizing properties	No data available

9.2 Other safety information

Bulk density	1.8 - 3.2 kg/m3

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
Dust may form explosive mixture in air.

10.4 Conditions to avoid

No data available

10.5 Incompatible materials

Strong oxidizing agents, Acids and bases

10.6 Hazardous decomposition products

Other decomposition products - No data available
In the event of fire: see section 5

---

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
No data available (Zinc powder (stabilized))

Inhalation: No data available (Zinc powder (stabilized))

Dermal: No data available (Zinc powder (stabilized))

No data available (Zinc powder (stabilized))

Skin corrosion/irritation
No data available (Zinc powder (stabilized))

Serious eye damage/eye irritation
No data available (Zinc powder (stabilized))

Respiratory or skin sensitisation
Did not cause sensitisation on laboratory animals. (Zinc powder (stabilized))

Germ cell mutagenicity
No data available (Zinc powder (stabilized))

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.
ACGIH:	No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by ACGIH.
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
No data available (Zinc powder (stabilized))

No data available (Zinc powder (stabilized))

Specific target organ toxicity - single exposure
No data available (Zinc powder (stabilized))

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available (Zinc powder (stabilized))

Additional Information
RTECS: ZG8600000

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

Effects due to ingestion may include:, chills, dry throat, sweet taste, Fever, Cough, Nausea, Vomiting, Weakness, Contact with eyes or skin may cause:, Irritation (Zinc powder (stabilized))

12. ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity to fish	LC50 - Cyprinus carpio (Carp) - 450 µg/l - 96 h (Zinc powder (stabilized))
Toxicity to daphnia and other aquatic invertebrates	LC50 - Daphnia magna (Water flea) - 0.068 mg/l - 48 h (Zinc powder (stabilized))
	mortality NOEC - Daphnia (water flea) - 0.101 - 0.14 mg/l - 7 d (Zinc powder (stabilized))

12.2 Persistence and degradability

The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

Bioaccumulation	Algae - 7 d at 16 °C - 5 µg/l (Zinc powder (stabilized)) Bioconcentration factor (BCF): 466

12.4 Mobility in soil

No data available (Zinc powder (stabilized))

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.

No data available

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.

14. TRANSPORT INFORMATION

DOT (US)
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substances, solid, n.o.s. (Zinc powder (stabilized))
Reportable Quantity (RQ): 1020 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. (Zinc powder (stabilized))
Marine pollutant:yes

IATA
UN number: 3077 Class: 9 Packing group: III
Proper shipping name: Environmentally hazardous substance, solid, n.o.s. (Zinc powder (stabilized))

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.

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
Zinc oxide	1314-13-2	2007-03-01
Zinc powder (stabilized)	7440-66-6	1993-04-24

SARA 311/312 Hazards

No SARA Hazards

Massachusetts Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

New Jersey Right To Know Components

	CAS-No.	Revision Date
Zinc powder (stabilized)	7440-66-6	1993-04-24
Zinc oxide	1314-13-2	2007-03-01

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.

16. OTHER INFORMATION

Full text of H-Statements referred to under sections 2 and 3.

	May form combustible dust concentrations in air
Aquatic Acute	Acute aquatic toxicity
Aquatic Chronic	Chronic aquatic toxicity
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.

HMIS Rating

Health hazard:	0
Chronic Health Hazard:	
Flammability:	0
Physical Hazard	0

NFPA Rating

Health hazard:	0
Fire Hazard:	0
Reactivity Hazard:	0

Further information

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

Preparation Information
Sigma-Aldrich Corporation
Product Safety – Americas Region
1-800-521-8956

Version: 5.8 Revision Date: 10/12/2015 Print Date: 05/01/2016

Safety Data Sheet

Revision Date: 08/13/18
www.restek.com

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

1. IDENTIFICATION

Catalog Number / Product Name:	**31272 / Benzo(b)fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	10
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Carcinogenicity Category 1B
Flammable Liquid Category 2
Serious Eye Damage/Eye Irritation Category 2
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Causes serious eye irritation.
May cause drowsiness or dizziness.
May cause cancer.

GHS Precautions:

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

First Aid Measures:
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
IF exposed or concerned: Get medical advice/attention.
Call a POISON CENTER or doctor/physician if you feel unwell.
If eye irritation persists: Get medical advice/attention.
In case of fire: Use extinguishing media in section 5 for extinction.

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

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

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

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.9
benzo (b) fluoranthene	205-99-2	205-911-9	0.1

4. FIRST-AID MEASURES

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

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

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

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

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

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

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

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

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

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

evaluation.

7. HANDLING AND STORAGE

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

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	**CAS No.**	**IDLH**	**ACGIH STEL**	**ACGIH TLV-TWA**	**OSHA Exposure Limit**
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL; 1782 mg/m3 STEL	500 ppm TWA; 1188 mg/m3 TWA	1000 ppm TWA; 2400 mg/m3 TWA
benzo (b) fluoranthene	205-99-2	Not established	None Known	Not established	No data available

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	No respiratory protection required under normal conditions of use. Provide general room exhaust ventilation if symptoms of overexposure occur as explained Section 3. A respirator is not normally required.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Medical Conditions Aggravated By Exposure:	Respiratory disease including asthma and bronchitis

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.0 (air = 1)
Boiling Point (°C):	56.05 °C at 1013.25 hPa
Melting Point (°C):	-95.4 °C Melting Point
Flash Point (°F):	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	465 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	0
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

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

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Respiratory Tract, Skin
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Can cause minor skin irritation, defatting, and dermatitis.
Eye Contact:	Can cause minor irritation, tearing and reddening.
Ingestion Irritation:	May be harmful if swallowed.
Ingestion Toxicity:	Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Upon prolonged or repeated contact, can cause minor skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Dermal LD50 Rabbit >15700 mg/kg; Inhalation LC50 Rat 50100 mg/m3 8 h; Oral LD50 Rat 5800 mg/kg

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.	
Benzo(b)fluoranthene	205-99-2	Present

ACGIH:

Chemical Name	CAS No.	
Benzo[b]fluoranthene	205-99-2	A2 - Suspected Human Carcinogen
Acetone	67-64-1	A4 - Not Classifiable as a Human Carcinogen

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	205-99-2	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	This material is not expected to be harmful to the ecology.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	No data
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

Waste Description of Spent Product:	Spent or discarded material is a hazardous waste.Mixing spent or discarded material with other materials may render the mixture hazardous. Perform a hazardous waste determination on mixtures.

Disposal Methods:	Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:	
DOT Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

International:	
IATA Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

Marine Pollutant: No

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

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
Acetone	67-64-1	X	-	-	X
benzo (b) fluoranthene	205-99-2	X	X	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Benzo[b]fluoranthene	205-99-2	Prop 65 Cancer

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
Acetone	67-64-1	X	X	X	X
benzo (b) fluoranthene	205-99-2	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	12/08/16
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

Safety Data Sheet

Revision Date: 06/15/18
www.restek.com

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

1. IDENTIFICATION

Catalog Number / Product Name:	**31274 / Benzo(k)fluoranthene Standard**
Company:	Restek Corporation
Address:	110 Benner Circle Bellefonte, Pa. 16823
Phone#:	814-353-1300
Fax#:	814-353-1309
Emergency#:	800-424-9300 (CHEMTREC) 703-527-3887 (Outside the US)
Email:	www.restek.com
Revision Number:	11
Intended use:	For Laboratory use only

2. HAZARD(S)IDENTIFICATION

Emergency Overview:

GHS Hazard Symbols:

GHS Classification:
Carcinogenicity Category 1B
Flammable Liquid Category 2
Serious Eye Damage/Eye Irritation Category 2
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 3

GHS Signal Word: Danger

GHS Hazard:
Highly flammable liquid and vapour.
Causes serious eye irritation.
May cause drowsiness or dizziness.
May cause cancer.

GHS Precautions:

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

First Aid Measures:
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
IF exposed or concerned: Get medical advice/attention.
Call a POISON CENTER or doctor/physician if you feel unwell.
If eye irritation persists: Get medical advice/attention.
In case of fire: Use extinguishing media in section 5 for extinction.

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

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

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

Repeated Exposure Target Organs: No data available

3. COMPOSITION / INFORMATION ON INGREDIENT

Chemical Name	CAS #	EINEC #	% Composition
Acetone	67-64-1	200-662-2	99.9
benzo (k) fluoranthene	207-08-9	205-916-6	0.1

4. FIRST-AID MEASURES

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

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

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

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

5. FIRE- FIGHTING MEASURES

Extinguishing Media: Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water spray or fog may also be effective for extinguishing if swept across the base of the fire. Water can also be used to absorb heat and keep exposed material from being damaged by fire. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

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

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

Hazardous Combustion Products: Carbon dioxide, Carbon monoxide

6. ACCIDENTAL RELEASE MEASURES

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

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

evaluation.

7. HANDLING AND STORAGE

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

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

United States:

Chemical Name	**CAS No.**	**IDLH**	**ACGIH STEL**	**ACGIH TLV-TWA**	**OSHA Exposure Limit**
Acetone	67-64-1	2500 ppm IDLH (10% LEL)	750 ppm STEL; 1782 mg/m3 STEL	500 ppm TWA; 1188 mg/m3 TWA	1000 ppm TWA; 2400 mg/m3 TWA
benzo (k) fluoranthene	207-08-9	Not established	None Known	Not established	No data available

Personal Protection:

Engineering Measures:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.
Respiratory Protection:	No respiratory protection required under normal conditions of use. Provide general room exhaust ventilation if symptoms of overexposure occur as explained Section 3. A respirator is not normally required.
Eye Protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Medical Conditions Aggravated By Exposure:	Respiratory disease including asthma and bronchitis

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance, color:	Depends upon product selection
Odor:	Strong
Physical State:	No data available
pH:	Not applicable
Vapor Pressure:	No data available
Vapor Density:	2.0 (air = 1)
Boiling Point (°C):	480 °C 56.05 °C at 1013.25 hPa
Melting Point (°C):	-95.4 °C Melting Point
Flash Point (°F):	39
Flammability:	Highly Flammable
Upper Flammable/Explosive Limit, % in air:	No data available
Lower Flammable/Explosive Limit, % in air:	No data available
Autoignition Temperature (°C):	465 deg C
Decomposition Temperature (°C):	No data available
Specific Gravity:	0.7845 g/cm3 at 25 °C
Evaporation Rate:	No data available
Odor Threshold:	ND
Solubility:	Complete; 100%
Partition Coefficient: n-octanol in water:	No data available
VOC % by weight:	0
Molecular Weight:	58.08

10. STABILITY AND REACTIVITY

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

11. TOXICOLOGICAL INFORMATION

Routes of Entry:	Inhalation, Skin Contact, Eye Contact, Ingestion

Target Organs Potentially Affected By Exposure:	Eyes, Central nervous system stimulation, Respiratory Tract, Skin
Chemical Interactions That Change Toxicity:	None Known

Immediate (Acute) Health Effects by Route of Exposure:

Inhalation Irritation:	Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Can cause minor skin irritation, defatting, and dermatitis.
Eye Contact:	Can cause minor irritation, tearing and reddening.
Ingestion Irritation:	May be harmful if swallowed.
Ingestion Toxicity:	Harmful if swallowed. May cause systemic poisoning.

Long-Term (Chronic) Health Effects:

Carcinogenicity:	Contains a probable or known human carcinogen.
Reproductive and Developmental Toxicity:	No data available to indicate product or any components present at greater than 0.1% may cause birth defects.
Inhalation:	Upon prolonged and/or repeated exposure, can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.
Skin Contact:	Upon prolonged or repeated contact, can cause minor skin irritation, defatting, and dermatitis.

Component Toxicological Data:

NIOSH:

Chemical Name	CAS No.	LD50/LC50
Acetone	67-64-1	Dermal LD50 Rabbit >15700 mg/kg; Inhalation LC50 Rat 50100 mg/m3 8 h; Oral LD50 Rat 5800 mg/kg

Component Carcinogenic Data:

OSHA:

Chemical Name	CAS No.	
Benzo(k)fluoranthene	207-08-9	Present

ACGIH:

Chemical Name	CAS No.	
Acetone	67-64-1	A4 - Not Classifiable as a Human Carcinogen

NIOSH:

Chemical Name	CAS No.
No data available	

NTP:

Chemical Name	CAS No.
No data available	

IARC:

Chemical Name	CAS No.	Group No.
Monograph 92 [2010]; Supplement 7 [1987]; Monograph 32 [1983]	207-08-9	Group 2B

12. ECOLOGICAL INFORMATION

Overview:	This material is not expected to be harmful to the ecology.
Mobility:	No data
Persistence:	No data
Bioaccumulation:	No data
Degradability:	No data
Ecological Toxicity Data:	No data available

13. DISPOSAL CONSIDERATIONS

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

	or Provincial regulations.
Waste Disposal of Packaging:	Comply with all Local, State, Federal, and Provincial Environmental Regulations.

14. TRANSPORTATION INFORMATION

United States:

DOT Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

International:

IATA Proper Shipping Name:	Acetone
UN Number:	UN1090
Hazard Class:	3
Packing Group:	II

Marine Pollutant: No

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

15. REGULATORY INFORMATION

United States:

Chemical Name	CAS#	CERCLA	SARA 313	SARA EHS 313	TSCA
Acetone	67-64-1	X	-	-	X
benzo (k) fluoranthene	207-08-9	X	X	-	-

The following chemicals are listed on CA Prop 65:

Chemical Name	CAS #	Regulation
Benzo[k]fluoranthene	207-08-9	Prop 65 Cancer

State Right To Know Listing:

Chemical Name	CAS#	New Jersey	Massachusetts	Pennsylvania	California
Acetone	67-64-1	X	X	X	X
benzo (k) fluoranthene	207-08-9	X	X	X	X

16. OTHER INFORMATION

Prior Version Date:	12/30/16
Other Information:	Any changes to the SDS compared to previous versions are marked by a vertical line in front of the concerned paragraph.
References:	No data available
Disclaimer:	Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only. Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

ACROS ORGANICS

Material Safety Data Sheet
Benzo[a]pyrene, 98%

MSDS# 37175

Section 1 - Chemical Product and Company Identification

MSDS Name:	Benzo[a]pyrene, 98%
Catalog Numbers:	AC105600000, AC105600010, AC105601000, AC377200000, AC377200010, AC377201000 AC377201000
Synonyms:	3,4-Benzopyrene; 3,4-Benzpyrene; Benzo[def]chrysene.

Company Identification:	Acros Organics BVBA Janssen Pharmaceuticalaan 3a 2440 Geel, Belgium
Company Identification: (USA)	Acros Organics One Reagent Lane Fair Lawn, NJ 07410
For information in the US, call:	800-ACROS-01
For information in Europe, call:	+32 14 57 52 11
Emergency Number, Europe:	+32 14 57 52 99
Emergency Number US:	201-796-7100
CHEMTREC Phone Number, US:	800-424-9300
CHEMTREC Phone Number, Europe:	703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#:	50-32-8
Chemical Name:	Benzo[a]pyrene
%:	>96
EINECS#:	200-028-5

Hazard Symbols: T N

Risk Phrases: 45 46 60 61 43 50/53

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Danger! May cause allergic skin reaction. Cancer hazard. May cause harm to the unborn child. May impair fertility. May cause eye, skin, and respiratory tract irritation. Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. May cause heritable genetic damage. Target Organs: Reproductive system, skin.

Potential Health Effects

Eye:	May cause eye irritation.
Skin:	May cause skin irritation. May be harmful if absorbed through the skin. May cause an allergic reaction in certain individuals.
Ingestion:	May cause irritation of the digestive tract. The toxicological properties of this substance have not been fully investigated. May be harmful if swallowed.
Inhalation:	May cause respiratory tract irritation. The toxicological properties of this substance have not been fully investigated. May be harmful if inhaled.

Chronic: May cause cancer in humans. May cause reproductive and fetal effects. Laboratory experiments have resulted in mutagenic 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. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse.

Ingestion: Never give anything by mouth to an unconscious person. Get medical aid. Do NOT induce vomiting. If conscious and alert, rinse mouth and drink 2-4 cupfuls of milk or water.

Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.

Notes to Physician:

Section 5 - Fire Fighting Measures

General Information: As in any fire, wear a self-contained breathing apparatus in pressure-demand, MSHA/NIOSH (approved or equivalent), and full protective gear. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.

Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or appropriate foam.

Autoignition Temperature: Not available.

Flash Point: Not available

Explosion Limits: Lower: Not available

Explosion Limits: Upper: Not available

NFPA Rating: health: 2; flammability: 0; instability: 0;

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.

Spills/Leaks: Clean up spills immediately, observing precautions in the Protective Equipment section. Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Use with adequate ventilation. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.

Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Benzo[a]pyrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Benzo[a]pyrene: 0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches)

Engineering Controls:

Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.

Exposure Limits

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:	A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements or European Standard EN 149 must be followed whenever workplace conditions warrant respirator use.

Section 9 - Physical and Chemical Properties

Physical State: Powder
Color: yellow to brown
Odor: faint aromatic odor
pH: Not available
Vapor Pressure: Not available
Vapor Density: Not available
Evaporation Rate: Not available
Viscosity: Not available
Boiling Point: 495 deg C @ 760 mm Hg (923.00°F)
Freezing/Melting Point: 175 - 179 deg C
Decomposition Temperature: Not available
Solubility in water: 1.60x10-3 mg/l @25°C
Specific Gravity/Density:
Molecular Formula: $C_{20}H_{12}$
Molecular Weight: 252.31

Section 10 - Stability and Reactivity

Chemical Stability:	Stable under normal temperatures and pressures.
Conditions to Avoid:	Dust generation.
Incompatibilities with Other Materials	Strong oxidizing agents.
Hazardous Decomposition Products	Carbon monoxide, carbon dioxide.
Hazardous Polymerization	Has not been reported.

Section 11 - Toxicological Information

RTECS#:	CAS# 50-32-8: DJ3675000
LD50/LC50:	RTECS: Not available.
Carcinogenicity:	Benzo[a]pyrene - ACGIH: A1 - Confirmed Human Carcinogen (Coal tar pitches). California: carcinogen, initial date 7/1/87 NTP: Suspect carcinogen IARC: Group 1 carcinogen
Other:	The toxicological properties have not been fully investigated.

Section 12 - Ecological Information

Not available

Section 13 - Disposal Considerations

Dispose of in a manner consistent with federal, state, and local regulations.

Section 14 - Transport Information

US DOT
Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOL (Benzo{a} pyrene)
Hazard Class: 9
UN Number: UN3077
Packing Group: III
Canada TDG
Shipping Name: Not available
Hazard Class:
UN Number:
Packing Group:

USA RQ: CAS# 50-32-8: 1 lb final RQ; 0.454 kg final RQ

Section 15 - Regulatory Information

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols: T N

Risk Phrases:

R 45 May cause cancer.

R 46 May cause heritable genetic damage.

R 61 May cause harm to the unborn child.

R 43 May cause sensitization by skin contact.

R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

R 60 May impair fertility.

Safety Phrases:

S 53 Avoid exposure - obtain special instructions before use.

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

S 60 This material and its container must be disposed of as hazardous waste.

S 61 Avoid release to the environment. Refer to special instructions/safety data sheets.

WGK (Water Danger/Protection)

CAS# 50-32-8: Not available

Canada

CAS# 50-32-8 is listed on Canada's DSL List

Canadian WHMIS Classifications: D2A, 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.

CAS# 50-32-8 is listed on Canada's Ingredient Disclosure List

US Federal

TSCA

CAS# 50-32-8 is listed on the TSCA Inventory.

Section 16 - Other Information

MSDS Creation Date: 9/02/1997

Revision #8 Date 7/20/2009

Safety Data Sheet

Prepared in accordance with Commission Regulation (EU) 2015/830

Stock Number: 31270
Revision Date: 13-08-2018
This document replaces SDS dated: 08-12-2016
2 Letter ISO country code/language code: UK/EN

Benzo(a)anthracene Standard

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

1.1 Product identifier: **Benzo(a)anthracene Standard**
Stock Number: 31270

Other means of identification:
Synonyms: None Known
REACH Registration No.: None Known
Molecular formula: CH3OH

1.2 Relevant identified uses of the substance or mixture and uses advised against:
Relevant identified uses: For Laboratory use only
Uses advised against: Uses other than recommended use.

	Manufacturer	**Supplier**
1.3 Details of the Supplier of the Safety Data Sheet:	Restek Corporation 110 Benner Circle Bellefonte, Pa. 16823 USA 00 1 814-353-1300 00 1 814-353-1309 sds@restek.com	Thames Restek UK LTD Units 8-16, Ministry Wharf Wycombe Road, Saunderton Buckinghamshire United Kingdom HP14 4HW 01494 563377 sales@thamesrestek.co.uk
1.4 Emergency telephone number:	00 1 800-424-9300 (CHEMTREC within the US)	0870-8200418 (CHEMTREC within the UK)
	00 1 703-741-5970 (Outside USA)	+1 703-741-5970 (CHEMTREC International)

Poison Centre contact information: National Poisons Information Service (NPIS)
Email: director.birmingham.unit@npis.org
Website: http://www.npis.org/

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture:

Classification according to Regulation (EC) No 1272/2008 [CLP]:
Carcinogenicity Category 1B
Specific Target Organ Systemic Toxicity (STOT) - Single Exposure Category 1

Flammable Liquid Category 2
Hazardous to the aquatic environment - Chronic Category 2
Acute Toxicity - Dermal Category 3
Acute Toxicity - Oral Category 3

2.2 Label elements:

Labelling according to Regulation (EC) No 1272/2008 [CLP]:

Hazard pictograms:




Signal Word: Danger

Hazard Statements:
H225 - Highly flammable liquid and vapour
H301+H311 - Toxic if swallowed or in contact with skin
H350 - May cause cancer.
H370 - Causes damage to organs
H411 - Toxic to aquatic life with long lasting effects

Precautionary Statements:
P201 - Obtain special instructions before use.

P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

P233 - Keep container tightly closed.

P260 - Do not breathe dust/fume/gas/mist/vapours/spray.

P280 - Wear protective gloves/protective clothing/eye protection/face protection.

P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor.

Supplemental Hazard information (EU): None Known

2.3 Other hazards: This substance does not meet the PBT or vPvB criteria of REACH, Annex XIII

SECTION 3: Composition/information on ingredients

3.1 Substances:
Not applicable

3.2 Mixtures:

Chemical Name	%	CAS #	EC No. REACH Registration No.	Classification (EC) No 1272/2008	M Factor	SCL	Acute Toxicity Estimates
benz (a) anthracene	0.1	56-55-3	200-280-6 None Known	Aquatic Acute 1; H400 Aquatic Chronic 1; H410 Carc. 1B; H350	AQUATIC CHRONIC 1: M = 100 AQUATIC ACUTE 1: M = 100	No data available	Not determined
methanol	99.9	67-56-1	200-659-6 None Known	Acute Tox. 3 (Dermal); H311 Acute Tox. 3 (Inh Dust/Mist); H331 Acute Tox. 3 (Oral); H301 Flam. Liq. 2; H225 STOT SE 1; H370	No data available	STOT SE 2: 3%<10% STOT SE 1: 10%	Not determined

For full text of H-statements see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures:

Inhalation:	Remove to fresh air. If breathing is difficult, have a trained individual administer oxygen. If not breathing, give artificial respiration and have a trained individual administer oxygen. Get medical attention immediately
Eye contact:	Flush eyes with plenty of water for at least 20 minutes retracting eyelids often. Tilt the head to prevent chemical from transferring to the uncontaminated eye. Get immediate medical attention.
Skin Contact:	Wash with soap and water. Remove contaminated clothing and launder. Get medical attention if irritation develops or persists.
Ingestion:	Do not induce vomiting and seek medical attention immediately. Drink two glasses of water or milk to dilute. Provide medical care provider with this SDS.
Self protection of the first aider:	No data available
4.2 Most important symptoms and	Coma and death

effects, both acute and delayed:	
4.3 Indication of any immediate medical attention and special treatment needed:	IF exposed or concerned: Get medical advice/ attention. IF exposed or concerned: Call a POISON CENTER/doctor. Call a POISON CENTER/doctor if you feel unwell.

SECTION 5: Firefighting measures

5.1 Extinguishing media:	
Suitable extinguishing media:	Use alcohol resistant foam, carbon dioxide, or dry chemical extinguishing agents. Water may be ineffective but water spray can be used extinguish a fire if swept across the base of the flames. Water can absorb heat and keep exposed material from being damaged by fire.
Unsuitable extinguishing media:	None Known
5.2 Special hazards arising from the substance or mixture:	Vapors may be ignited by sparks, flames or other sources of ignition if material is above the flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.
Hazardous Combustion Products:	Carbon dioxide, Carbon monoxide
5.3 Advice for firefighters:	Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. Flammable component(s) of this material may be lighter than water and burn while floating on the surface.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Non-emergency personnel:	Non-emergency personnel should be kept clear of the area
Emergency responders:	Exposure to the spilled material may be severely irritating or toxic. Follow personal protective equipment recommendations found in Section 8 of this SDS. Personal protective equipment needs must be evaluated based on information provided on this sheet and the special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred, and the expertise of employees in the area responding to the spill. Never exceed any occupational exposure limits.
6.2 Environmental precautions:	No data available
6.3 Methods and material for containment and cleaning up:	
Small spills:	Refer to information provided for large spills
Large spills:	Prevent the spread of any spill to minimize harm to human health and the

	environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section 8 at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation.
6.4 Reference to other sections:	Refer to section 13 for disposal information

SECTION 7: Handling and storage

7.1 Precautions for safe handling:	Toxic or severely irritating material. Avoid contacting and avoid breathing the material. Use only in a well ventilated area. Use spark-proof tools and explosion-proof equipment
7.2 Conditions for safe storage, including any incompatibilities:	
Conditions for safe storage:	Store in a cool dry ventilated location. Isolate from incompatible materials and conditions. Keep container(s) closed. Keep away from sources of ignition
Materials to Avoid/Chemical Incompatibility:	Strong oxidizing agents
7.3 Specific end use(s):	For Laboratory use only

SECTION 8: Exposure controls/personal protection

8.1 Control parameters:

Occupational Exposure limit values:

Chemical Name	United Kingdom - Workplace Exposure Limits (WELs) - TWAs	United Kingdom - Workplace Exposure Limits (WELs) - STELs	United Kingdom - Biological Monitoring Guidance Values
methanol	200 ppm TWA; 266 mg/m3 TWA	250 ppm STEL; 333 mg/m3 STEL	No data available

DNEL:	None Known
PNEC:	None Known

8.2 Exposure controls:

Appropriate engineering controls:	Local exhaust ventilation is recommended when generating excessive levels of vapours from handling or thermal processing.

Individual protection measures, such as personal protective equipment:

Eye and face protection:	Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses.
Skin Protection:	
Hand protection:	No information available

Other skin protection:	Wear protective gloves. Inspect gloves for chemical break-through and replace at regular intervals. Clean protective equipment regularly. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work
Respiratory Protection:	If an exposure limit is exceeded or if an operator is experiencing symptoms of inhalation overexposure as explained in Section 3, provide respiratory protection. Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms.
Respirator Type(s):	None required where adequate ventilation is provided. If airborne concentrations are above the applicable exposure limits, use NIOSH/MSHA approved respiratory protection.
Thermal Hazards:	Not applicable
Environmental exposure controls:	No data available

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties:

Appearance:	No data available
Colour:	No data available
Odour:	Mild
Odour threshold:	No data available
pH:	Not applicable
Melting Point/Freezing Point (°C):	
Melting point (°C):	No data available
Freezing point (°C):	No data available
Initial boiling point and boiling range (°C):	65
Flash point (°C):	11
Evaporation Rate (water = 1):	No data available
Flammability (solid, gas):	No data available
Upper/lower flammability or explosive limits:	
Upper flammable or explosive limit, % in air:	36
Lower flammable or explosive limit, %	6

in air:

Vapour pressure:	No data available
Vapor Density (Air=1):	1.1
Relative density (water = 1):	0.800
Solubility(ies):	Moderate; 50-99%
Partition coefficient: n-octanol/water:	No data available
Auto-ignition temperature (°C):	464
Decomposition temperature (°C):	No data available
Viscosity:	No data available
Explosive properties:	No data available
Oxidizing properties:	No data available

9.2 Other information:

Volatile Organic Chemicals:	0
Bulk density:	6.676

SECTION 10: Stability and reactivity

10.1 Reactivity:	Not expected to be reactive
10.2 Chemical stability:	Stable under normal conditions.
10.3 Possibility of hazardous reactions:	None expected under standard conditions of storage
10.4 Conditions to avoid:	No data available
10.5 Incompatible materials:	Strong oxidizing agents
10.6 Hazardous decomposition products:	Carbon dioxide, Carbon monoxide

SECTION 11: Toxicological information

11.1 Information on toxicological effects:

Acute toxicity:

Chemical Name	ORAL LD50 (rat)	DERMAL LD50 (rabbit)	INHALATION LC50 (rat)
methanol	No data available	No data available	INHALATION LC50-8H Rat 22500 ppm

Classification has been based on toxicological information of the components in Section 3.

Skin corrosion/irritation:
Based on available data, the classification criteria are not met.

Serious eye damage/irritation:
Based on available data, the classification criteria are not met.

Respiratory or skin sensitisation:
Based on available data, the classification criteria are not met.

Germ cell mutagenicity:
Based on available data, the classification criteria are not met.

Carcinogenicity:
Classification has been based on toxicological information of the components in Section 3.

Reproductive toxicity:
Based on available data, the classification criteria are not met.

STOT-single exposure:
Classification has been based on toxicological information of the components in Section 3.

STOT-repeated exposure:
Based on available data, the classification criteria are not met.

Aspiration hazard:
Based on available data, the classification criteria are not met.

SECTION 12: Ecological information

12.1 Toxicity: Moderate ecological hazard. This product may be dangerous to plants and/or wildlife.

Ecological Toxicity Data:

Chemical Name	CAS #	Aquatic EC50 Crustacea	Aquatic ERC50 Algae	Aquatic LC50 Fish
No data available				

12.2 Persistence and degradability: Biodegrades slowly.

12.3 Bioaccumulative potential: No data available

12.4 Mobility in soil: No data available

12.5 Results of PBT and vPvB assessment: No data available

12.6 Other adverse effects:	None Known
12.7 Additional information:	No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods:

Disposal methods:	Spent or discarded material is a hazardous waste. Dispose of by incineration following Federal, State, Local, or Provincial regulations.
Waste codes / waste designations according to LoW:	No data available

SECTION 14: Transport information

International carriage of dangerous goods by road (ADR), rail or inland waterways:

14.1 UN number:	UN1230
14.2 UN proper shipping name:	Methanol
14.3 Transport hazard class(es):	3(6.1)
14.4 Packing group:	II

International carriage of dangerous goods by air (IATA):

14.1 UN number:	UN1230
14.2 UN proper shipping name:	Methanol
14.3 Transport hazard class(es):	3(6.1)
14.4 Packing group:	II

14.5 Environmental hazards:	Yes
14.6 Special precautions for user:	No data available
14.7 Transport in bulk according to Annex II of MARPOL and the IBC Code:	No data available

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture:

Chemical Name	EINECS	SVHC
methanol	Yes	No

benz (a) anthracene	Yes	No

15.2 Chemical Safety Assessment	No Chemical Safety Assessment has been carried out for this substance/mixture by the supplier.

SECTION 16: Other information

Revision Date: 13-08-2018

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

Abbreviations and acronyms:

CAS = Chemical Abstract Service
DNEL= Derivative No Effect Level
EC= European Community
EINECS = European Inventory of Existing Chemical Substances
MSHA = Mine Safety Health Administration
NIOSH = National Institute of Occupational Safety & Health
OEL = Occupational Exposure Limit
PBT= Persistent, Bioaccumulative, Toxic
PNEC= Predicted No Effect Concentration
SCOEL= Scientific Committee on Occupational Exposure Limits
TLV = Threshold Limit Value
TWA= Time Weighted Average
vPvB= Very Persistent, Very Bioaccumulative
Wt.% = Weight Percent

Key literature references and sources for data: No data available

Hazard phrase(s) referenced in section 3

H350 - May cause cancer.

H225 - Highly flammable liquid and vapour

H301+H311+H331 - Toxic if swallowed, in contact with skin or if inhaled

H370 - Causes damage to organs

H410 - Very toxic to aquatic life with long lasting effects

Precautionary Statements:

Prevention:

P201 - Obtain special instructions before use.

P202 - Do not handle until all safety precautions have been read and understood.

	P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. 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 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.
Response:	P301+P310 - IF SWALLOWED: Immediately call a POISON CENTER/doctor. P302+P352 - If on skin: Wash with plenty of water. P303+P361+P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. P308+P311 - IF exposed or concerned: Call a POISON CENTER/doctor. P308+P313 - IF exposed or concerned: Get medical advice/ attention. P312 - Call a POISON CENTER/doctor if you feel unwell. P321 - Specific treatment (see Sections 4 to 8 on this SDS and any additional information on this label). P330 - Rinse mouth. P361+P364 - Take off immediately all contaminated clothing and wash it before reuse. P370+P378 - In case of fire: Use an appropriate extinguisher (see section 5) to extinguish. P391 - Collect spillage.
Storage:	P233 - Keep container tightly closed. P403+P235 - Store in a well-ventilated place. Keep cool. P405 - Store locked up.
Disposal:	P501 - Dispose of contents/container to a suitable disposal site in accordance with local/national/international regulations.

Disclaimer of Liability: Restek Corporation provides the descriptions, data and information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. It is provided for your guidance only.

Because many factors may affect processing or application/use, Restek Corporation recommends you perform an assessment to determine the suitability of a product for your particular purpose prior to use. No warranties of any kind, either expressed or implied, including fitness for a particular purpose, are made regarding products described, data or information set forth. In no case shall the descriptions, information, or data provided be considered a part of our terms and conditions of sale. Further, the descriptions, data and information furnished hereunder are given gratis. No obligation or liability for the description, data and information given are assumed. All such being given and accepted at your risk.

Material Safety Data Sheet
Chrysene, 98%

ACC# 95251

Section 1 - Chemical Product and Company Identification

MSDS Name: Chrysene, 98%
Catalog Numbers: AC224140000, AC224140010, AC224140050, AC224145000
Synonyms: 1,2-Benzophenanthrene; Benzo(a)phenanthrene; 1,2,5,6-Dibenzonaphthalene.
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
218-01-9	Chrysene	98	205-923-4

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: very light beige solid.
Caution! May cause eye and skin irritation. May cause respiratory tract irritation. May cause cancer in humans.
Target Organs: Liver, skin.

Potential Health Effects
Eye: May cause eye irritation.
Skin: May cause skin irritation.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea.
Inhalation: May cause respiratory tract irritation.
Chronic: May cause cancer according to animal studies.

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. Wash clothing before reuse.
Ingestion: Do not induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Get medical aid immediately. Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.
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. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion. This material in sufficient quantity and reduced particle size is capable of creating a dust explosion.
Extinguishing Media: Use water spray, dry chemical, carbon dioxide, or chemical foam.
Flash Point: Not applicable.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: ; Flammability: 1; Instability:

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Vacuum or sweep up material and place into a suitable disposal container. Clean up spills immediately, observing precautions in the Protective Equipment section. Wear a self contained breathing apparatus and appropriate personal protection. (See Exposure Controls, Personal Protection section). Provide ventilation.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Wash thoroughly after handling. Avoid contact with eyes, skin, and clothing. Use only with adequate ventilation. Avoid breathing dust.
Storage: Store in a tightly closed container. Store in a cool, dry area away from incompatible substances.

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 process enclosure, local exhaust ventilation, or other engineering controls to control airborne levels.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Chrysene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Chrysene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: very light beige
Odor: Not available.
pH: Not available.
Vapor Pressure: Not available.
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 448 deg C @ 760 mm Hg
Freezing/Melting Point:250-255 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density: Not available.
Molecular Formula:$C_{18}H_{12}$
Molecular Weight:228.29

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Dust generation.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 218-01-9: GC0700000
LD50/LC50:
Not available.

Carcinogenicity:
CAS# 218-01-9:

- **ACGIH:** A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans
- **California:** carcinogen, initial date 1/1/90
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: Chrysene was mutagenic to S. Typhimurium in the presence of an exogenous metabolic system.
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

Ecotoxicity: Water flea LC50 = 1.9 mg/L; 2 Hr.; Unspecified Fish toxicity : LC50 (96hr) Neauthes arenacedentata >1ppm.(Rossi,S.S. et al Marine Pollut. Bull. 1978) Invertebrate toxicity : lethal treshold concentration (24hr) Daphnia Magna 0,7æg/l.(* Newsted,J.L. et al Environ. Toxicol. Chem. 1987) Bioaccumulation : 24hr Daphnia Magna log bioconcentration factor 3.7845 (*)
Environmental: Degradation studies : biodegradated by white rot fungus (Proc.Annu.Meet.Am.Wood-Preserv.Assoc.1989) May be utilised by axenic cultures of microorganisms e.g. Pseudomonas pancimobilis EPA505, which may have novel degradative systems(Mueller,J.G. et al ppl.Environ.Microbiol.1990; Mueller, J.G. et al Environ.Sci.Technol.1991).
Physical: Not found.
Other: No information available.

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# 218-01-9: waste number U050.

Section 14 - Transport Information

	US DOT	Canada TDG
Shipping Name:	DOT regulated - small quantity provisions apply (see 49CFR173.4)	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 218-01-9 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# 218-01-9: 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.
Section 313
This material contains Chrysene (CAS# 218-01-9, 98%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:

This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.

Clean Water Act:

None of the chemicals in this product are listed as Hazardous Substances under the CWA. CAS# 218-01-9 is listed as a Priority Pollutant under the Clean Water Act.

None of the chemicals in this product are listed as Toxic Pollutants under the CWA.

OSHA:

None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 218-01-9 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 Chrysene, a chemical known to the state of California to cause cancer.
California No Significant Risk Level: CAS# 218-01-9: 0.35 æg/day NSRL (oral)

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

T

Risk Phrases:

R 45 May cause cancer.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S 53 Avoid exposure - obtain special instructions before use.
S 60 This material and its container must be disposed of as hazardous waste.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 218-01-9: No information available.

Canada - DSL/NDSL

CAS# 218-01-9 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of D2A.

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all of the information required by those regulations.

Canadian Ingredient Disclosure List

CAS# 218-01-9 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 6/30/1999
Revision #5 Date: 11/20/2008

SAFETY DATA SHEET (SDS)

For Welding Consumables and Related Products
Conforms to the criteria of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS),
OSHA Hazard Communication Standard 29CFR 1910.1200
Standard Must Be Consulted for Specific Requirements

SECTION I – IDENTIFICATION of Product and Company

Manufacturer/Supplier: Washington Alloy Company	Recommended use:	Restriction on use:	Telephone No: 704-598-1325
Address: 7010-G Reames Rd, Charlotte, NC 28216	Welding, Filler Metal, Brazing	Not Known	Emergency No: 704-598-1325
Trade Name of Magnesium: AZ61A, AZ92A, AZ101A			Specification: AWS A5.19

SECTION II – COMPOSITION / INFORMATION ON INGREDIENTS

GHS Hazard Classification: STOT SE 3 (H336, H335), (H372), Aquatic Acute 1 (H400)/ **Label Elements** - Hazard symbol and Signal word =


GHS07


GHS08


GHS09

Danger

Hazard statement and Precautionary statement =

Very toxic to aquatic life, Causes damage to organs through prolonged or repeated exposure, May cause drowsiness or dizziness, May cause respiratory irritation.; Wash thoroughly after handling. Do not eat, drink or smoke when using this product Do not breathe dust/fume/gas/mist/vapors/spray. Avoid breathing dust/fume/gas/mist/vapor/spray.. Use only outdoors or in a well-ventilated area. Avoid release to the environment. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/doctor if you feel unwell. Get medical advice and attention if you feel unwell. Collect spillage. Store in a well-ventilated place; Keep container tightly closed. Store locked up. Dispose of contents/container in accordance with local/ regional/ national/ international regulations. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted.

Other Hazards which do not result in GHS classification and Overview: Electric shock can kill. Wear approved head, hand and body protection, which help to prevent injury from radiation, sparks and electrical shock. Welding arc and sparks can ignite combustibles or flammable materials. See ANSI Z-49.1. This would include wearing welder's gloves and a protective face shield and may include arm protectors, apron, hats, shoulder protection, as well as dark substantial clothing. Welders should be trained not to allow electrically live parts to contract the skin or wet clothing and gloves. The welders should insulate themselves from the work and ground. Arc Rays can injure eyes and burn skin. Read and understand the manufacturer's instructions and precautionary label on this product and your employer's safety practices. See Section XIII.

As shipped these are odorless, solid rods that are nonflammable, non-explosive, non-reactive and non –hazardous with a metallic luster.

Substance: Welding fumes and gases cannot be classified simply. The composition and quantity of these fumes and gases are dependent upon the metal being welded, the procedures followed, and the electrodes used. Fumes may affect eyes, skin, respiratory system as well as pancreas and liver.

Workers should be aware that the composition and quantity of fumes and gases to which they may be exposed, are influenced by: coatings which may be present on the metal being welded (such as paint, plating, or galvanizing), the number of welders in operation and the volume of the work area, the quality and amount of ventilation, the position of the welder's head with respect to the fume plume, as well as the presence of contaminants in the atmosphere (such as chlorinated hydrocarbon vapors from cleaning and degreasing procedure). When the electrode is consumed, the fumes and gas decomposition products generated are different in percent and form from the ingredients listed in Section III, The composition of these fumes and gases are the concerning matter and not the composition of the electrode itself. Decomposition products include those originating from the volatilization, reaction, or oxidation of the ingredients shown in Section III, plus those from the base metal, coating and the other factors noted above. Reasonable expected fume constituents of this product would include: Complex oxides or compounds of chromium, magnesium, manganese, silicon, copper, aluminum, zinc and may be present. (Other complex oxides may be present when using fluxes).

Ingredients listed in Section III

Chemical Identity	CAS No.	EINECS#
Carbon dioxide	124-38-9	204-696-9
Carbon monoxide	630-8-0	211-128-3
Nitrogen dioxide	10102-44-0	-
Ozone	10028-15-6	233-069-2
Manganese (Mn)	7439-96-5	231-105-1

SECTION III – COMPOSITION / INFORMATION ON INGREDIENTS

*The term "HAZARDOUS MATERIALS" should be interpreted as a term required and defined in OSHA HAZARD COMMUNICATION STANDARD 29 CFR 1910.1200 however the use of this term does not necessarily imply the existence of any hazard.

Chemical Identity Ingredients	CAS No.	EINECS#	Composition percent in Weight (%)		
			AZ61A	AZ92A	AZ101A
Aluminum	7429-90-5	231-072-3	5.8-7.2	8.3-9.7	9.5-10.5
Zinc (Zn) Fume(1)	7440-66-6	231-175-3	0.40-1.5	1.7-2.3	0.75-1.25
Beryllium	7440-41-7	231-150-7	0.0002-0.0008		
Copper	7440-50-8	231-159-6	0.05		
Manganese (Mn) (limits as fume) (1)	7439-96-5	231-105-1	0.15-0.5		
Iron	7439-89-6	231-096-4	0.005		
Silicon (Si)	7440-21-3	231-130-8	0.05		
Magnesium (Mg)	7439-95-4	231-104-6	Balance		
Nickel (Ni)	7440-02-0	231-111-4	0.005		

Other elements or ingredients may be present but in quantities much less than 1%. (1) Subject to reporting requirements of Section 302, 304, 311, 312, and 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and 40CFR 370 and 372; (Resp) = Respiratory/ Respiration: Welding and cutting of products that contain Chromium may produce hexavalent chromium and YOU should read and follow OSHA's final rules Fed Register #:71:10099-10385 dated 02-28-2006. Occupational Safety and Health Administration 29 CFR 1910.1000 Permissible Exposure Limit (PEL). American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV[R]). *Ceiling Limit **Short Term Exposure Limit Single values are maximum

SECTION IV – FIRST AID MEASURES

Contact with skin, eyes, ingestion or injection should not be a source for exposure with proper protection.

Ingestion: Avoid contact with metal fume or powers which may lead to ingestion which may be harmful. Do not induce vomiting unless directed by medical personnel. Rinse mouth with water if conscious. Call a physician or poison control center immediately.

Inhalation: If breathing has stop or difficult move to fresh air and as needed perform artificial respiration. Call medical assistance or physician.

Skin Contact: Remove any contaminated clothing, gloves or other personnel equipment and promptly wash/flush with mild soap and water. For reddish or blistered skin from thermal/arc radiation promptly wash/flush with water. Get medical assistance or physician help as needed.

Eye Contact: Arc radiation can injure eyes and cause an arc flash – if this occurs, move to dark room removing lenses as required and get rest and cover eyes with non-stick dressings (padded dressing) Removal of dust and fumes requires flushing with abundant amounts of clean water for at least 15 minutes. Get medical assistance or physician help as needed or if issues persist.

Most important symptoms/effects, acute and delayed:

Symptoms: Short-term (acute) overexposure to welding fumes may result in discomfort such as metal fume fever, dizziness, nausea, dryness or irritation of nose, throat, or eyes. Pre-existing respiratory issues may be aggregated. Long-term (chronic) over-exposure to welding fumes can lead to siderosis (iron deposits in lung) and is believed to affect pulmonary function. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted.

Hazards: Welding fumes and gases cannot be classified simply. Refer to Section II under Substance and Section VIII

SECTION V – FIRE-FIGHTING MEASURES

As shipped these are odorless, solid rods that are nonflammable, non-explosive, non-reactive and non –hazardous. Welding arcs and sparks can ignite combustibles or flammable materials Read and understand the manufacturer's instructions and precautionary label on this product and your employer's safety practices. Read and understand: American National Standard ANSI Z49.1 *Safety in Welding, Cutting and Allied Processes*, published by the AMERICAN WELDING SOCIETY, 550 N.W. LeJeune Road, Miami, Florida 33126; OSHA *Safety and Health Standards* are published by the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401. Also, National Fire Protection Association NFPA 51B, *Standard for Fire Prevention During Welding, Cutting and other Hot Work; Also See NFPA 651*

Suitable (and unsuitable) extinguishing media: As shipped these items will not burn however in the event use media recommended for the burning materials and fire situation and surroundings. No unsuitable media known at this time. Do not use water or halogenated on molten metals.

Specific hazards arising from the chemicals: Welding arcs and sparks can ignite combustibles or flammable materials

Specific protective equipment and precautions for firefighters: Wear self-contained breathing apparatus and full protective clothing in case of fire or when fumes and vapors are present. Follow general fire-fighting precautions as in the workplace. Do not allow run off to enter drains or water sources.

SECTION VI – ACCIDENTAL RELEASE MEASURES

Personal Precautions, protective equipment and emergency procedures: With airborne dust and fumes, be sure to use adequate engineering ventilation controls and personal protection to prevent overexposure limits recommendations found in Section VIII.
Environment precautions: Control work practices to eliminate environmental release. These products are solid metal rods, with no spill or leak hazards as shipped. If product becomes molten dam up with sand type media until it cools back to a solid and reuse/recycle as scrap.
Methods and Materials for containment and cleaning up: Solid rods can be picked up and placed back in the original container. Clean up immediately while following all safety guidelines as well as using all personal protection safety listed in section VIII. Avoid generating dust and prevent materials from entering and drains, sewers or water sources. Disposal considerations found in Section XIII. When fumes and vapors are present follow general fire-fighting precautions as in the workplace and all applicable regulations

SECTION VII – HANDLING AND STORAGE

Precautions for safe handling: Handle with care wearing gloves and keep formation of airborne dust and fumes to a minimum. If needed use adequate engineering ventilation controls and personal protection to prevent overexposure limits recommendations found in Section VIII. Also read American National Standard ANSI Z49.1 *Safety in Welding, Cutting and Allied Processes*, published by the AMERICAN WELDING SOCIETY, 550 N.W. LeJeune Road, Miami, Florida 33126; OSHA *Safety and Health Standards* are published by the U.S. Government Printing Office, 732 North Capitol Street NW, Washington, DC 20401. Do not eat or drink while using these products and ensure proper ventilation is used. Wash hands after use. **Conditions for safe storage, including any incompatibilities:** All employees who handle these products should be trained to handle it safely. Open packages of these products/containers on a safe stable surface and must be properly labeled at all times. Store products in original closed packages, cool dry place, while avoiding extreme temperatures or incompatible items such as acids, strong bases, oxidizers and halogens. Always follow all regulations in accordance with local/regional/state/national guidelines.

SECTION VIII – EXPOSURE CONTOLS/PERSONAL PROTECTION

Control parameters

Flux or other ingredients	CAS No.	EINECS#	Exposure Limit (mg/m^3)	
			OSHA PEL	ACGIH TLV
Iron (Fe) (limits as oxide fume)	7439-89-6	231-096-4	10	5 (Resp)
Manganese (Mn) (limits as fume) (1)	7439-96-5	231-105-1	1 , 3.0** , 5*	0.02 (Resp) 0.1***
Silicon (Si)	7440-21-3	231-130-8	15 (dust) 5 (Resp)	WITHDRAWN
Nickel (Ni) (1)	7440-02-0	231-111-4	1	1.5 (inhalable fraction)
Copper (Cu) (A) (1)	7440-50-8	231-159-6	1 (dust) 0.1(fume)	1 (dust) 0.2 (fume)
Magnesium (Mg)	7439-95-4	231-105-1	15 (total particulate)	10
Zinc (Zn) Fume(1)	7440-66-6	231-175-3	5 mg/m3 5 mg/m3 (Resp) 15 mg/m3 (total dust)	2 (Resp)10**
Beryllium	7440-41-7	239-981-7	0.002, 0.005 Ceiling, 0.025 for 30 minutes	0.00005***
Aluminum (Al) (1) (2)	7429-90-5	231-072-3	15 (total dust) 5 (Resp)	10 (dust)1 (Resp)

Other elements or ingredients may be present but in quantities much less than 1%.(1) Subject to reporting requirements of Section 302, 304, 311, 312, and 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and 40CFR 370 and 372; (Resp) = Respiratory/ Respiration: Welding and cutting of products that contain Chromium may produce hexavalent chromium and YOU should read and follow OSHA's final rules Fed Register #:71:10099-10385 dated 02-28-2006. Occupational Safety and Health Administration 29 CFR 1910.1000 Permissible Exposure Limit (PEL). American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV[R]). *Ceiling Limit **Short Term Exposure Limit ***Inhalable fraction **ACGIH** - **A**merican **C**onference of **G**overnmental **I**ndustrial **H**ygienists, a professional association which establishes exposure limits used a guideline in control for health hazards but not an indication of safe and dangerous exposure limits **TLV - Threshold Limit Value** - an airborne concentration of a substance, which represents conditions under which it is generally believed that nearly all workers, may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour & **BEI** - Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. **OSHA** - U.S. Occupational Safety and Health Administration. **PEL - Permissible Exposure Limit** - this exposure value means the same as a TLV, except that it is limits guideline by OSHA. **Eye Protection:** Wear a helmet or face shield with a filter lens shade number 12-14 or darker for arc welding. Shield other workers by providing screens and flash goggles. Use face-shield with filter lens of appropriate shade number (per ANSI Z49.1-1988, "Safety in Welding and Cutting"). **Protective Clothing:** Wear approved head, hand and body protection, which help to prevent injury from radiation, sparks and electrical shock. See ANSI Z-49.1. This would include wearing welder's gloves and a protective face shield and may include arm protectors, apron, hats, shoulder protection, as well as dark substantial clothing. Welders should be trained not to allow electrically live parts to contract the skin or wet clothing and gloves. The welders should insulate themselves from the work and ground.
Ventilation: Use plenty of ventilation and/or local exhaust at the arc, to keep the fumes and gases below the threshold limit value within the worker's breathing zone and the general work area. Welders should be advised to keep their head out of the fumes.

Respiratory Protection: Use respirable fume respirator or air supplied respirator when welding in a confined space or general work area where local exhaust and/or ventilation does not keep exposure below the threshold limit value.

HYGIENE/ WORK PRACTICES: With all chemicals/materials, avoid getting these products ON YOU or IN YOU. Wash hands after handling these products. Do not eat or drink while handling these products. Use ventilation and other engineering controls to minimize potential exposure to these products.

SECTION IX – PHYSICAL AND CHEMICAL PROPERTIES

Appearance / Color / Odor / Physical state / Form: Solid rods that are nonflammable, non-explosive, non-reactive and non –hazardous with a metallic luster. **Odor Threshold / pH / Flash Point / Evaporation Rate / Flammability (Solid, Gas) / Upper & Lower Flammability or Explosive Limits:** No data available **Vapor Pressure & Density / Relative Density / / Partition coefficient (n-octanol/water) / Auto-ignition Decomposition temperature:** No data available **MELTING POINT**: 1112°F (600 °C) SPECIFIC GRAVITY N/A **Solubility(water/other); Insoluble**

SECTION X – STABILITY and REACTIVITY

Chemical stability: These products are considered stable as shipped and under normal conditions
Possibility of hazard reactions: No data and will not occur
Conditions to avoid: Avoid exposure to extreme temperatures, Incompatible materials
Incompatible materials: Incompatible items such as acids, oxidizers, halogens, Strong bases, mineral acids, and halogens.
Hazardous decomposition products: Read Substance in Section II. Welding and cutting of products that contain Chromium may produce hexavalent chromium and YOU should read and follow OSHA's final rules Fed Register #:71:10099-10385 dated 02-28-2006. Occupational Safety and Health Administration 29 CFR 1910.1000 Permissible Exposure Limit (PEL). The best method to determine the actual composition of generated fumes and gases is to take an air sample from inside the welder's helmet if worn or in breathing zone. For additional information, refer to the American Welding Society Publication, "Fumes and Gases in the Welding Environment".

SECTION XI- TOXICOLOGICAL INFORMATION

Oral/Dermal/inhalation: **Acute oral toxicity;** Iron: (Human-child); TDLo: 77 mg/kg. Oral (rat); LD50:30 gm/kg. Intraperitoneal (rabbit); LDLo: 20 mg/kg. Oral (guinea pig); LD50:20 gm/kg. Oral (rat); TDLo: 63 gm/kg/6W-C. Inhalation (rat); 250 mg/m3/6H/4W-I. Intratracheal (rat); TDLo: 450 mg/kg/15W-I. Silicon: Acute oral toxicity (LD50): 3160 mg/kg [Rat]. Manganese: Acute oral toxicity (LD50): 9000 mg/kg [Rat].; TCLo 2300 mg/m3 (inhalation human central nervous); Silicon : Acute oral toxicity (LD50): 3160 mg/kg [Rat].; Copper: Acute oral toxicity (TDLo): 12 mg/kg, gastrointestinal effects; Zinc: (TDLo): 124 mg//m3/50mins, pulmonary effects of skin; **Skin corrosion or irritation / Serious eye damage or irritation / Respiratory or skin sensitization / Germ cell mutagenicity / Reproductive toxicity / Specific target organ toxicity – single exposure / Specific target organ toxicity – repeated exposure**: Not classified **Carcinogenicity:** Overall Evaluation of welding fume and Nickel is listed by IARC as possibly carcinogenic to humans (Group 2B). **National Toxicology Program** (NTP) list Nickel with Reasonably Anticipated to be a Human Carcinogen; Nickel and compounds pose a respiratory cancer risk, and may give skin itch to dermatitis Arc Rays can injure eyes and burn skin. Skin cancer has been reported **Information on the likely routes of exposures: Ingestion** is not a likely route of exposure for this product or expected under normal use. If swallowed call physician immediately! Do not induce vomiting unless directed by medical personnel. Rinse mouth with water if person is conscious. Never give fluids or induce vomiting if person is unconscious, having convulsions, or not breathing. **Inhalation** of welding fumes and gases can be dangerous to your health. **Skin/Eye Contact:** Arc Rays can injure eyes and burn skin. Skin cancer has been reported. **IARC**- has classified welding fumes as a possible carcinogenic to humans (Group 2B) **Symptoms related to physical, chemical and toxicological characteristics: Inhalation:** Short-term(acute) overexposure to welding fumes may result in discomfort such as metal fume fever, dizziness, nausea, dryness or irritation of nose, throat, or eyes. Pre-existing respiratory issues may be aggregated. Long-term (chronic) over-exposure to welding fumes can lead to siderosis (iron deposits in lung) and is believed to affect pulmonary function. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted. **Delayed and immediate effects and also chronic effects from short and long-term exposure:** There are no immediate health hazards associated with the wire or rod form of this product. Skin, respiratory, pancreas, and liver disorders may be aggravated by prolonged over-exposures to the dusts or fumes generated by these products. Pre-existing respiratory issues may be aggregated. Long-term (chronic) over-exposure to welding fumes can lead to siderosis (iron deposits in lung) and is believed to affect pulmonary function. Manganese and Manganese compounds above safe exposure limits can affect or cause irreversible damage to the central nervous system, including the brain: symptoms may result in impaired speech and movement, lack of energy, stiffness in legs, feet, toes, muscular weakness as well as psychological disturbances. Reports of bronchitis and lung fibrosis have also been noted. Treat symptoms and eliminate overexposure.
Other information during use: **Inhalation acute toxicity**: Carbon dioxide LC Lo (Human, 5 min): 90000 ppm Carbon monoxide LC 50 (Rat, 4 h): 1,300 mg/l Nitrogen dioxide LC 50 (Rat, 4 h): 88 ppm

SECTION XII- TOXICOLOGICAL INFORMATION

Ecotoxicity: Iron = LC50 Channel catfish (Ictalurus punctatus) > 500 mg/l, 96 hours**; Manganese** = EC 50 (Water flea (Daphnia magna), 48 h): 40 mg/l; **Nickel** LC50 Fathead minnows (Pimephales promelas) 2.916 mg/l, 96 hours**,** *EC50 Water flea* (Daphnia obtusa) 1 mg/l, 48 hours **; Aluminum** (Al) LC 50 (Grass carp, white amur (Ctenopharyngodon idella) 96 h): 0.21-0.31 mg/l**: Copper** LC50 Fathead minnows (Pimephales promelas) 1.6 mg/l, 96 hours**,** *EC50 Water flea* (Daphnia obtusa) 0.102 mg/l, 48 hours **; Specified substance(s):** Nickel Zebra mussel (Dreissana polymorpha), Bioconcentration Factor (BCF): 5,000 – 10,000 (lotic) Biocencentration factor calculated using dry weight tissue concentration: Copper and/or copper alloys and compounds (as Cu) Blue-green algae (Anacystis nidulans), Bioconcentration Factor (BCF): 36.01 (Static); **Persistence and Degradability / Bioaccumulative Potential / Mobility in Soil:** No data

Other Adverse Effects: Possibly harmful to aquatic life. Do not allow material to be released to the environment without proper governmental permits. No further relevant information available.

SECTION XIII- DISPOSAL CONCIDERATIONS

Disposal Methods: Avoid or minimize generating waste**.** When possible collect scrap and by-products with proper id for recycling. Waste disposal must be in accordance with appropriate Federal, National, Provincial, State, and local regulations. These products, if unaltered by use, may be disposed of by treatment at a permitted facility or as advised by your local hazardous waste regulatory authority.

SECTION XIV- TRANSPORT INFORMATION

UN Number / UN Proper shipping name / Transport Hazard class (es)/ Packing group / Marine pollutant / Special Precautions: Not Regulated as Dangerous Good or Not Regulated, No international regulations

SECTION XV- REGULATORY INFORMATION

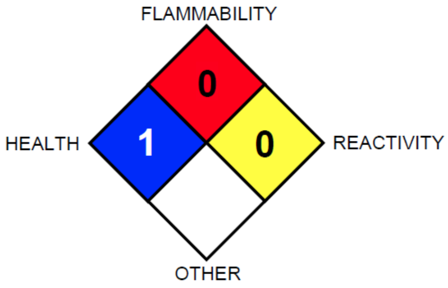
United States: TSCA INVENTORY STATUS: The components of these products are listed on the TSCA Inventory; **CERCLA REPORTABLE QUANTITY (RQ):** Beryllium, Nickel, Copper, Manganese, Zinc, Manganese = Reportable quantity: Included in the regulation but with no data values. See regulation (40 CFR 302.4). **EPCRA/SARA Title III 313 Toxic Chemicals** The following metallic components are listed as SARA 313 "Toxic Chemicals" and potential subject to annual SARA 313 reporting. See Section III for weight percent. Ingredient & Disclosure threshold: Aluminum, Chromium, Copper, Manganese, Vanadium, Zinc all @ 1.0% de minimis concentration: Hexavalent chromium compounds 0.1% de minimis concentration N090; Zinc oxide 1.0% de minimis concentration N982
Superfund Amendments and Reauthorization Act 1986 (SARA): As shipped: Immediate (Acute) In use: Immediate delayed (Delayed)

California Proposition 65: ⚠**WARNING**: This product may expose you to chemicals including [Cobalt (II) Oxide, Titanium dioxide (airborne, unbound particles of respirable size), Chromium (hexavalent compounds), Nickel, Lead and Lead Compounds, Carbon Black, Cadmium, Beryllium and Beryllium Compounds] which are known to the State of California to cause cancer, and [Chromium (hexavalent compounds), Nickel, Lead and Lead Compounds, Cadmium] which are known to the State of California to cause birth defects and/or other reproductive harm. For more information go to https://www.p65warnings.ca.gov/
Beryllium and Nickel, is on the California Proposition 65 lists. Hexavalent chromium compounds, Beryllium, Nickel, listed in the following- Carcinogens & Reproductive Toxic Listed Substance, Carcinogenic Substance 2/27/1987, Developmental Toxin 12/19/2008, Female Reproductive Toxin 12/19/2008, Male Reproductive Toxin 12/19/2008
US State Regulations list: See Section III for contents and weight percent
Alaska-Designated Toxic and Hazardous Substances: Aluminum Welding Fumes, Manganese,
California-Permissible Exposure Limits for Chemical Contaminants: Aluminum, Aluminum oxide, Beryllium, Nickel, Manganese, Silicon, Magnesium, Magnesium Oxide, Copper, Iron, Iron oxide, Zinc and Zinc oxide
Florida-Substance List: Aluminum, Manganese,
Illinois-Toxic Substance List: Aluminum, Copper, Manganese, and Silicon.
Kansas-Section 302/313 List: Aluminum, Copper, and Manganese.
Massachusetts-Substance List: Aluminum, Aluminum oxide, Beryllium, Nickel, Copper, Magnesium, Magnesium Oxide, Manganese, Iron oxide, Silicon, Zinc, Zinc oxide
Michigan - Critical Materials Register: Copper.
Minnesota-List of Hazardous Substances: Aluminum Welding Fumes, Beryllium, Nickel, Copper, Manganese, and Silicon.
Missouri-Employer Information/Toxic Substance List: Aluminum, Copper, Manganese, Molybdenum, Silicon,
New Jersey-Right to Know Hazardous Substance List Aluminum, Aluminum oxide, Copper, Iron oxide, Magnesium, Magnesium Oxide, Manganese, Silicon, Beryllium, Nickel, Zinc oxide
North Dakota-List of Hazardous Chemicals, Reportable Quantities: Copper.
Pennsylvania-Hazardous Substance List: Aluminum, Aluminum oxide, Copper, Iron oxide, Iron oxide, Magnesium, Manganese, Silicon, Welding Fume, Zinc oxide Beryllium, Nickel,
Rhode Island-Hazardous Substance List: Aluminum Welding Fumes, Manganese, Silicon, and Zirconium.
Texas-Hazardous Substance List: Manganese,
West Virginia-Hazardous Substance List: Manganese,
Wisconsin-Toxic and Hazardous Substances: Manganese,

SECTION XVI- OTHER INFORMATION

Approval Date:5-29-2018 NEW SDS Number: 014-MAG
NFPA CODES: FIRE: 0 HEALTH: 1 REACTIVITY: 0
U.S. DOT = Material is not hazardous and is not considered as a dangerous item.
Washington Alloy Co. Believes that the information contained in this (SDS) Safety Data Sheet is accurate. However, Washington Alloy Co. does not express or implies any warranty with respect to this information.
Download the most current SDS and product information @ www.weldingwire.com

NFPA RATING



SAFETY DATA SHEET

Creation Date 08-Nov-2010 **Revision Date** 16-Jan-2019 **Revision Number** 6

1. Identification

Product Name	**Fluoranthene**
Cat No. :	**AC119170000; AC119170250; AC119171000; AC119175000**
CAS-No	206-44-0
Synonyms	Benzo[j,k]fluorene
Recommended Use	Laboratory chemicals.
Uses advised against	Food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 4

Label Elements

Signal Word
Warning

Hazard Statements
Harmful if swallowed

Precautionary Statements
Prevention
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Fluoranthene	206-44-0	>95

4. First-aid measures

General Advice	If symptoms persist, call a physician.
Eye Contact	Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.
Skin Contact	Wash off immediately with plenty of water for at least 15 minutes. If skin irritation persists, call a physician.
Inhalation	Move to fresh air. If not breathing, give artificial respiration. Get medical attention if symptoms occur.
Ingestion	Clean mouth with water and drink afterwards plenty of water. Get medical attention if symptoms occur.
Most important symptoms and effects	None reasonably foreseeable.
Notes to Physician	Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media	Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Unsuitable Extinguishing Media	No information available
Flash Point	Not applicable
Method -	No information available
Autoignition Temperature	No information available
Explosion Limits	
Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products

Carbon monoxide (CO) Carbon dioxide (CO_2)

Protective Equipment and Precautions for Firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
2	0	0	N/A

6. Accidental release measures

Personal Precautions	Ensure adequate ventilation. Use personal protective equipment. Avoid dust formation.
Environmental Precautions	Should not be released into the environment.
Methods for Containment and Clean Up	Sweep up or vacuum up spillage and collect in suitable container for disposal. Keep in suitable, closed containers for disposal.

7. Handling and storage

Handling	Ensure adequate ventilation. Wear personal protective equipment. Avoid dust formation. Do not get in eyes, on skin, or on clothing. Avoid ingestion and inhalation.
Storage	Keep in a dry, cool and well-ventilated place. Keep container tightly closed.

8. Exposure controls / personal protection

Exposure Guidelines	This product does not contain any hazardous materials with occupational exposure limitsestablished by the region specific regulatory bodies.
Engineering Measures	Ensure adequate ventilation, especially in confined areas. Ensure that eyewash stations and safety showers are close to the workstation location.

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	Long sleeved clothing.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Powder Solid
Appearance	Light green
Odor	Odorless
Odor Threshold	No information available
pH	Not applicable
Melting Point/Range	109 - 111 °C / 228.2 - 231.8 °F
Boiling Point/Range	384 °C / 723.2 °F
Flash Point	Not applicable
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	

Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	No information available
Specific Gravity	No information available
Solubility	insoluble
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	C16 H10
Molecular Weight	202.25

10. Stability and reactivity

Reactive Hazard	None known, based on information available
Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products.
Incompatible Materials	Strong oxidizing agents
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2)
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Fluoranthene	LD50 = 2 g/kg (Rat)	LD50 = 3180 mg/kg (Rabbit)	Not listed

Toxicologically Synergistic Products No information available

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

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Fluoranthene	206-44-0	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects	No information available
Reproductive Effects	No information available.
Developmental Effects	No information available.
Teratogenicity	No information available.
STOT - single exposure	None known
STOT - repeated exposure	None known

Aspiration hazard	No information available
Symptoms / effects,both acute and delayed	No information available
Endocrine Disruptor Information	No information available
Other Adverse Effects	The toxicological properties have not been fully investigated. See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Fluoranthene	Not listed	Oncorhynchus mykiss: LC50=0.0077 mg/L 96h	Not listed	EC50: 0.78 mg/L 20h

Persistence and Degradability	No information available
Bioaccumulation/ Accumulation	No information available.
Mobility	.

Component	log Pow
Fluoranthene	5.1

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
Fluoranthene - 206-44-0	U120	-

14. Transport information

DOT

UN-No	UN3077
Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
Proper technical name	Fluoranthene
Hazard Class	9
Packing Group	III

TDG

UN-No	UN3077
Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
Hazard Class	9
Packing Group	III

IATA

UN-No	UN3077
Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
Hazard Class	9
Packing Group	III

IMDG/IMO

UN-No	UN3077
Proper Shipping Name	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
Hazard Class	9
Packing Group	III

15. Regulatory information

All of the components in the product are on the following Inventory lists: 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 Europe China Canada TSCA Japan X = listed Australia U.S.A. (TSCA) Canada (DSL/NDSL) Europe (EINECS/ELINCS/NLP) Australia (AICS) Korea (ECL) China (IECSC) Japan (ENCS) Philippines (PICCS) Complete Regulatory Information contained in following SDS's

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Fluoranthene	X	-	X	205-912-4	-		-	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 %
Fluoranthene	206-44-0	>95	1.0 0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Fluoranthene	-	-	X	X

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Fluoranthene	100 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
Fluoranthene	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	08-Nov-2010
Revision Date	16-Jan-2019
Print Date	16-Jan-2019
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

End of SDS

Material Safety Data Sheet
Phenanthrene, 98+%

ACC# 96981

Section 1 - Chemical Product and Company Identification

MSDS Name: Phenanthrene, 98+%
Catalog Numbers: AC130090000, AC130090050, AC130090500, AC130091000, AC130095000
Synonyms:
Company Identification:

Acros Organics N.V.
One Reagent Lane
Fair Lawn, NJ 07410

For information in North America, call: 800-ACROS-01
For emergencies in the US, call CHEMTREC: 800-424-9300

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
85-01-8	Phenanthrene	>98.0	201-581-5

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: brown.
Warning! Harmful if swallowed. May cause allergic skin reaction. May cause eye, skin, and respiratory tract irritation. Cancer suspect agent.
Target Organs: Skin.

Potential Health Effects

Eye: May cause eye irritation.
Skin: May cause skin irritation. May be harmful if absorbed through the skin. May cause an allergic reaction in certain individuals.
Ingestion: Harmful if swallowed. May cause irritation of the digestive tract.
Inhalation: May be harmful if inhaled. Inhalation of dust may cause respiratory tract irritation.
Chronic: Limited evidence of a carcinogenic effect.

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 imme diately.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
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. Dusts at sufficient concentrations can form explosive mixtures with air. During a fire, irritating and highly toxic gases may be generated by thermal decomposition or combustion.
Extinguishing Media: Use water spray or dry chemical.
Flash Point: Not available.
Autoignition Temperature: Not available.
Explosion Limits, Lower: Not available.
Upper: Not available.
NFPA Rating: (estimated) Health: 2; Flammability: 1; Instability: 0

Section 6 - Accidental Release Measures

General Information: Use proper personal protective equipment as indicated in Section 8.
Spills/Leaks: Sweep up, then place into a suitable container for disposal. Avoid generating dusty conditions. Provide ventilation. Do not let this chemical enter the environment.

Section 7 - Handling and Storage

Handling: Wash thoroughly after handling. Remove contaminated clothing and wash before reuse. Minimize dust generation and accumulation. Avoid contact with eyes, skin, and clothing. Keep container tightly closed. Avoid ingestion and inhalation.
Storage: Store in a tightly closed container. Store in a cool, dry, well-ventilated area away from incompatible substances.

Section 8 - Exposure Controls, Personal Protection

Engineering Controls: Facilities storing or utilizing this material should be equipped with an eyewash facility and a safety shower. Use adequate ventilation to keep airborne concentrations low.
Exposure Limits

Chemical Name	ACGIH	NIOSH	OSHA - Final PELs
Phenanthrene	0.2 mg/m3 TWA (as benzene soluble aerosol) (listed under Coal tar pitches).	0.1 mg/m3 TWA (cyclohexane-extractable fraction) (listed under Coal tar pitches).80 mg/m3 IDLH (listed under Coal tar pitches).	0.2 mg/m3 TWA (benzene soluble fraction) (listed under Coal tar pitches).

OSHA Vacated PELs: Phenanthrene: No OSHA Vacated PELs are listed for this chemical.
Personal Protective Equipment
Eyes: Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin: Wear appropriate protective gloves to prevent skin exposure.
Clothing: Wear appropriate protective clothing to prevent skin exposure.
Respirators: Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Section 9 - Physical and Chemical Properties

Physical State: Solid
Appearance: brown
Odor: None reported
pH: Not available.
Vapor Pressure: 1 mm Hg @116c
Vapor Density: Not available.
Evaporation Rate: Not available.
Viscosity: Not available.
Boiling Point: 340 deg C
Freezing/Melting Point:101 deg C
Decomposition Temperature: Not available.
Solubility: insoluble
Specific Gravity/Density:1.0630g/cm3
Molecular Formula:C14H10
Molecular Weight:178.23

Section 10 - Stability and Reactivity

Chemical Stability: Stable under normal temperatures and pressures.
Conditions to Avoid: Incompatible materials, dust generation, strong oxidants.
Incompatibilities with Other Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide, carbon dioxide.
Hazardous Polymerization: Has not been reported.

Section 11 - Toxicological Information

RTECS#:
CAS# 85-01-8: SF7175000
LD50/LC50:
CAS# 85-01-8:
  Oral, mouse: LD50 = 700 mg/kg;
  Oral, rat: LD50 = 1.8 gm/kg;
.

Carcinogenicity:
CAS# 85-01-8:

- **ACGIH:** A1 - Confirmed Human Carcinogen (listed as 'Coal tar pitches').
- **California:** Not listed.
- **NTP:** Known carcinogen (listed as Coal tar pitches).
- **IARC:** Group 1 carcinogen (listed as Coal tar pitches).

Epidemiology: No information found
Teratogenicity: No information found
Reproductive Effects: No information found
Mutagenicity: No information found
Neurotoxicity: No information found
Other Studies:

Section 12 - Ecological Information

No information available.

Section 13 - Disposal Considerations

Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. Additionally, waste generators must consult state and local hazardous waste regulations to ensure complete and accurate classification.
RCRA P-Series: None listed.
RCRA U-Series: None listed.

Section 14 - Transport Information

	US DOT	**Canada TDG**
Shipping Name:	Not regulated as a hazardous material	No information available.
Hazard Class:		
UN Number:		
Packing Group:		

Section 15 - Regulatory Information

US FEDERAL

TSCA
CAS# 85-01-8 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# 85-01-8: 5000 lb final RQ; 2270 kg final RQ
SARA Section 302 Extremely Hazardous Substances
None of the chemicals in this product have a TPQ.
SARA Codes
CAS # 85-01-8: immediate.
Section 313
This material contains Phenanthrene (CAS# 85-01-8, >98.0%),which is subject to the reporting requirements of Section 313 of SARA Title III and 40 CFR Part 373.
Clean Air Act:
This material does not contain any hazardous air pollutants.
This material does not contain any Class 1 Ozone depletors.
This material does not contain any Class 2 Ozone depletors.
Clean Water Act:
None of the chemicals in this product are listed as Hazardous Substances under the CWA. CAS# 85-01-8 is listed as a Priority Pollutant under the Clean Water Act.
None of the chemicals in this product are listed as Toxic Pollutants under the CWA.
OSHA:
None of the chemicals in this product are considered highly hazardous by OSHA.

STATE

CAS# 85-01-8 can be found on the following state right to know lists: California, New Jersey, Pennsylvania, Minnesota, (listed as Coal tar pitches), Massachusetts.

California Prop 65

California No Significant Risk Level: None of the chemicals in this product are listed.

European/International Regulations

European Labeling in Accordance with EC Directives

Hazard Symbols:

XN N

Risk Phrases:

R 22 Harmful if swallowed.
R 40 Limited evidence of a carcinogenic effect.
R 50/53 Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Safety Phrases:

S 29 Do not empty into drains.
S 36/37 Wear suitable protective clothing and gloves.
S 61 Avoid release to the environment. Refer to special instructions /safety data sheets.

WGK (Water Danger/Protection)

CAS# 85-01-8: No information available.

Canada - DSL/NDSL

CAS# 85-01-8 is listed on Canada's DSL List.

Canada - WHMIS

This product has a WHMIS classification of 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# 85-01-8 is listed on the Canadian Ingredient Disclosure List.

Section 16 - Additional Information

MSDS Creation Date: 7/14/1998
Revision #5 Date: 5/05/2009

The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- The most likely source of exposure is ingestion of contaminated food and drinking water. Exposure can also occur via inadvertent ingestion of contaminated soil/dust or lead-based paint.
- Lead can leach into drinking water from lead-soldered joints or leaded pipes in water distribution systems or individual houses. Lead may also enter foods if they are put into improperly glazed pottery or ceramic dishes.
- Some non-Western folk remedies may contain substantial amounts of lead. Some types of hair dyes and cosmetics may contain lead compounds.
- Other potential sources of exposure are hobbies that use lead: casting ammunition and m fishing weights; soldering with lead solder; making stained glass; using firing ranges. Leaded gasoline is still used in some race cars, airplanes, and off-road vehicles.

Occupational Populations

- Potentially high levels of lead may occur in the following industries: lead smelting and refining industries, battery manufacturing plants, steel welding or cutting operations, construction, rubber products and plastics industries, printing industries, firing ranges, radiator repair shops and other industries requiring flame soldering of lead solder.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- Approximately 95% of deposited inorganic lead that is inhaled is absorbed.
- The extent and rate of gastrointestinal absorption of inorganic lead are influenced by the physiological state of the exposed individual and the species of the lead compound.
- Gastrointestinal absorption of lead is higher in children (40–50%) than in adults (3–10%). The presence of food in the gastrointestinal tract decreases absorption.
- Absorption of lead from soil is less than that of dissolved lead, but is similarly depressed by meals (26% fasted; 2.5% when ingested with a meal).
- In adults, about 94% of the total amount of lead in the body is contained in the bones and teeth versus about 73% in children.
- The elimination half-lives for inorganic lead in blood and bone are approximately 30 days and 27 years, respectively.
- Independent of the route of exposure, absorbed lead is excreted primarily in urine and feces.

Normal Human Levels

- Lead levels in blood (geometric mean, 1999-2002):

  1.9 µg/dL for children 1-5 years
  1.5 µg/dL for adults 20–59 years
- Lead levels in urine (geometric mean, 2001-2002):

  0.677 µg/L for ≥6 years of age

Biomarkers/Environmental Levels

Biomarkers

- Analysis of lead in whole blood is the most common and accurate method of assessing lead exposure. Erythrocyte protoporphyrin (EP) tests can also be used, but are not as sensitive at low blood lead levels (<20 µg/dL). Lead in blood reflects recent exposure.
- Bone lead measurements are an indicator of cumulative exposure.
- Measurements of urinary lead levels and hair have been used to assess lead exposure; however, they are not as reliable.

Environmental Levels

Air

- The concentration of lead in air samples (2002) is <0.05 $\mu g/m^3$.

Sediment and Soil

- The natural lead content of soil typically ranges from <10 to 30 µg/g. However, lead levels in the top layers of soil vary widely due to deposition and accumulation of atmospheric particulates from anthropogenic sources.

Water

- Levels of lead in surface water and groundwater in the U.S. range between 5 and 30 µg/L.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Lead

Pb

CAS# 7439-92-1
October 2007

U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

Contact Information:
Division of Toxicology and Environmental Medicine
Applied Toxicology Branch

1600 Clifton Road NE, F-32
Atlanta, GA 30333
1-800-CDC-INFO
1-800-232-4636

www.atsdr.cdc.gov/toxpro2.html

The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Chemical and Physical Information

Lead is a metal

- Lead is a naturally-occurring bluish-gray metal that is rarely found in its elemental form, but occurs in the Earth's crust primarily as the mineral galena (PbS), and to a lesser extent as anglesite ($PbSO_4$) and cerussite ($PbCO_3$).
- Lead is not a particularly abundant element, but its ore deposits are readily accessible and widely distributed throughout the world. Its properties, such as corrosion resistance, density, and low melting point, make it a familiar metal in pipes, solder, weights, and storage batteries.
- Natural lead is a mixture of four stable isotopes, ^{208}Pb (51–53%), ^{206}Pb (23.5–27%), ^{207}Pb (20.5–23%), and ^{204}Pb (1.35–1.5%). Lead isotopes are the stable decay product of three naturally radioactive elements: ^{205}Pb from uranium, ^{207}Pb from actinium, and ^{208}Pb from thorium.

Routes of Exposure

- Inhalation – Primary route for occupational exposure. Larger particles (>2.5 µm) that are deposited in the ciliated airways (nasopharyngeal and tracheobronchial regions) can be transferred by mucociliary transport into the esophagus and swallowed.
- Oral – Primary route of exposure for the general population.
- Dermal – Studies in animals have shown that organic lead is well absorbed through the skin.

Lead in the Environment

- Lead is dispersed throughout the environment primarily as the result of anthropogenic activities. In the air, lead is in the form of particles and is removed by rain or gravitational settling.
- The fate of lead in soil is affected by the adsorption at mineral interfaces, which are dependent upon physical and chemical characteristics of the soil (e.g., pH, soil type, particle size, organic matter content).
- Sources of lead in dust and soil can include lead from weathering and chipping of lead-based paint from buildings, bridges, and other structures.
- The solubility of lead compounds in water is a function of pH, hardness, salinity, and the presence of humic material. Solubility is highest in soft, acidic water.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

- MRLs were not derived for lead because a clear threshold for some of the more sensitive effects in humans has not been identified.
- In lieu of MRLs, ATSDR has developed a framework to guide decisions at lead sites. This approach utilizes site-specific exposure data to estimate internal doses as measured by blood lead levels (PbBs) (see Appendix D in the Toxicological Profile).

Health Effects

Hematological

- Decreased activity of several heme biosynthesis enzymes at PbB <10 µg/dL.

Gastrointestinal

- Colic in children – PbB 60–100 µg/dL.

Cardiovascular

- Elevated blood pressure – PbB<10 µg/dL.

Renal

- Decreased glomerular filtration rate at mean PbB <20 µg/dL.

Neurological

- Encephalopathy – PbB100–120 µg/dL (adults) 70–100 µg/dL (children).
- Peripheral neuropathy – PbB40 µg/dL.
- Neurobehavioral and neuropsychological effects in adults – PbB40–80 µg/dL.
- Cognitive and neurobehavioral effects in children at PbB <10 µg/dL.

Reproductive

- Reduced fertility – PbB>40 µg/dL.

Children's Health

- Children are more vulnerable to the effects of lead than adults.
- The most common source of lead exposure for children is lead-based paint.
- Lead exposures during infancy or childhood may result in anemia, neurological impairment, renal alterations, colic, and impaired metabolism of vitamin D.
- Lead exposures either *in utero*, during infancy, or during childhood may result in delays or impairment of neurological development, neurobehavioral deficits including IQ deficits, low birth weight, and low gestational age, growth retardation, and delayed sexual maturation in girls.
- Ensuring a diet that is nutritionally adequate in calcium and iron may decrease the absorbed dose of lead.

Mercury - ToxFAQs™

CAS # 7439-97-6

This fact sheet answers the most frequently asked health questions (FAQs) about mercury. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is mercury?

Mercury is a naturally occurring metal which has several forms. The metallic mercury is a shiny, silver-white, odorless liquid. If heated, it is a colorless, odorless gas.

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts," which are usually white powders or crystals. Mercury also combines with carbon to make organic mercury compounds. The most common one, methylmercury, is produced mainly by microscopic organisms in the water and soil. More mercury in the environment can increase the amounts of methylmercury that these small organisms make.

Metallic mercury is used to produce chlorine gas and caustic soda, and is also used in thermometers, some dental fillings, and batteries. Mercury salts are sometimes used in skin lightening creams and as antiseptic creams and ointments.

What happens to mercury when it enters the environment?

- Inorganic mercury (metallic mercury and inorganic mercury compounds) enters the air from mining ore deposits, burning coal and waste, and from manufacturing plants.
- It enters the water or soil from natural deposits, disposal of wastes, and volcanic activity.
- Methylmercury may be formed in water and soil by small organisms called bacteria.
- Methylmercury builds up in the tissues of fish. Larger and older fish tend to have the highest levels of mercury.

How might I be exposed to mercury?

- Eating fish or shellfish contaminated with methylmercury.
- Breathing vapors in air from spills, incinerators, and industries that burn mercury-containing fossil fuels.
- Release of mercury from dental work and medical treatments.
- Breathing contaminated workplace air or skin contact during use in the workplace.
- Practicing rituals that include mercury.

How can mercury affect my health?

The nervous system is very sensitive to all forms of mercury. Methylmercury and metallic mercury vapors are more harmful than other forms, because more mercury in these forms reaches the brain. Exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems.

Short-term exposure to high levels of metallic mercury vapors may cause effects including lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation.

Mercury

CAS # 7439-97-6

How likely is mercury to cause cancer?

There are inadequate human cancer data available for all forms of mercury. Mercuric chloride has caused increases in several types of tumors in rats and mice, and methylmercury has caused kidney tumors in male mice. The EPA has determined that mercuric chloride and methylmercury are possible human carcinogens.

How can mercury affect children?

Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there, possibly causing damage to the developing nervous system. It can also pass to a nursing infant through breast milk. However, the benefits of breast feeding may be greater than the possible adverse effects of mercury in breast milk.

Mercury's harmful effects that may affect the fetus include brain damage, mental retardation, incoordination, blindness, seizures, and inability to speak. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage.

How can families reduce the risk of exposure to mercury?

Carefully handle and dispose of products that contain mercury, such as thermometers or fluorescent light bulbs. Do not vacuum up spilled mercury, because it will vaporize and increase exposure. If a large amount of mercury has been spilled, contact your health department. Teach children not to play with shiny, silver liquids.

Properly dispose of older medicines that contain mercury. Keep all mercury-containing medicines away from children.

Pregnant women and children should keep away from rooms where liquid mercury has been used.

Learn about wildlife and fish advisories in your area from your public health or natural resources department.

Is there a medical test to determine whether I've been exposed to mercury?

Tests are available to measure mercury levels in the body. Blood or urine samples are used to test for exposure to metallic mercury and to inorganic forms of mercury. Mercury in whole blood or in scalp hair is measured to determine exposure to methylmercury. Your doctor can take samples and send them to a testing laboratory.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 2 parts of mercury per billion parts of drinking water (2 ppb).

The Food and Drug Administration (FDA) has set a maximum permissible level of 1 part of methylmercury in a million parts of seafood (1 ppm).

The Occupational Safety and Health Administration (OSHA) has set limits of 0.1 milligram of organic mercury per cubic meter of workplace air (0.1 mg/m^3) and 0.05 mg/m^3 of metallic mercury vapor for 8-hour shifts and 40-hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Arsenic - ToxFAQs™

CAS # 7440-38-2

This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to higher than average levels of arsenic occur mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found in at least 1,149 of the 1,684 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Copper chromated arsenate (CCA) is used to make "pressure-treated" lumber. CCA is no longer used in the U.S. for residential uses; it is still used in industrial applications. Organic arsenic compounds are used as pesticides, primarily on cotton fields and orchards.

What happens to arsenic when it enters the environment?

- Arsenic occurs naturally in soil and minerals and may enter the air, water, and land from wind-blown dust and may get into water from runoff and leaching.
- Arsenic cannot be destroyed in the environment. It can only change its form.
- Rain and snow remove arsenic dust particles from the air.
- Many common arsenic compounds can dissolve in water. Most of the arsenic in water will ultimately end up in soil or sediment.
- Fish and shellfish can accumulate arsenic; most of this arsenic is in an organic form called arsenobetaine that is much less harmful.

How might I be exposed to arsenic?

- Ingesting small amounts present in your food and water or breathing air containing arsenic.
- Breathing sawdust or burning smoke from wood treated with arsenic.
- Living in areas with unusually high natural levels of arsenic in rock.
- Working in a job that involves arsenic production or use, such as copper or lead smelting, wood treating, or pesticide application.

How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs.

Ingesting very high levels of arsenic can result in death. Exposure to lower levels can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Almost nothing is known regarding health effects of organic arsenic compounds in humans. Studies in animals show that some simple organic arsenic compounds are less toxic than inorganic forms. Ingestion of methyl and dimethyl compounds can cause diarrhea and damage to the kidneys.

How likely is arsenic to cause cancer?

Several studies have shown that ingestion of inorganic arsenic can increase the risk of skin cancer and cancer in the liver, bladder, and lungs. Inhalation of inorganic arsenic can cause increased risk of lung cancer. The Department of Health and Human Services (DHHS) and the EPA have determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans.

How can arsenic affect children?

There is some evidence that long-term exposure to arsenic in children may result in lower IQ scores. There is also some evidence that exposure to arsenic in the womb and early childhood may increase mortality in young adults.

There is some evidence that inhaled or ingested arsenic can injure pregnant women or their unborn babies, although the studies are not definitive. Studies in animals show that large doses of arsenic that cause illness in pregnant females, can also cause low birth weight, fetal malformations, and even fetal death. Arsenic can cross the placenta and has been found in fetal tissues. Arsenic is found at low levels in breast milk.

How can families reduce the risks of exposure to arsenic?

- If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
- If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.
- If you work in a job that may expose you to arsenic, be aware that you may carry arsenic home on your clothing, skin, hair, or tools. Be sure to shower and change clothes before going home.

Is there a medical test to determine whether I've been exposed to arsenic?

There are tests available to measure arsenic in your blood, urine, hair, and fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict whether the arsenic levels in your body will affect your health.

Has the federal government made recommendations to protect human health?

The EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or cancelled many of the uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit (PEL) of 10 micrograms of arsenic per cubic meter of workplace air ($10\ \mu g/m^3$) for 8 hour shifts and 40 hour work weeks.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic (Update). Atlanta, GA: U.S. Department of Health and Human Services. Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Polychlorinated Biphenyls - ToxFAQs™

This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List (NPL) sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

- PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
- PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
- PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
- PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

- Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
- Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
- Breathing air near hazardous waste sites and drinking contaminated well water.
- In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. PCBs have been classified as probably carcinogenic, and carcinogenic to humans (group 1) by the Environmental Protection Agency (EPA) and International Agency for Research on Cancer (IARC), respectively.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risks of exposure to PCBs?

- You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.
- Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.
- Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.
- If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to PCBs?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

http://www.epa.gov/pesticides/factsheets/riskassess.htm
Last updated on Wednesday, May 09, 2012

Pesticides: Topical & Chemical Fact Sheets

Assessing Health Risks from Pesticides

Este Web page está disponible en español

Current as of: April 5, 2007
735-F-99-002

Questions on Pesticides?

- Contact the National Pesticide Information Center (NPIC) 1-800-858-7378

The Federal Government, in cooperation with the States, carefully regulates pesticides to ensure that they do not pose unreasonable risks to human health or the environment. As part of that effort, the Environmental Protection Agency (EPA) requires extensive test data from pesticide producers that demonstrate pesticide products can be used without posing harm to human health and the environment. EPA scientists and analysts carefully review these data to determine whether to register (license) a pesticide product or a use and whether specific restrictions are necessary. This fact sheet is a brief overview of EPA's process for assessing potential risks to human health when evaluating pesticide products.

Background

There are more than 1055 active ingredients registered as pesticides, which are formulated into thousands of pesticide products that are available in the marketplace.

EPA plays a critical role in evaluating these chemicals prior to registration, and in reevaluating older pesticides already on the market, to ensure that they can be used with a reasonable certainty of no harm. The process EPA uses for evaluating the health impacts of a pesticide is called risk assessment.

EPA uses the National Research Council's four-step process for human health risk assessment:

Step One: Hazard Identification
Step Two: Dose-Response Assessment
Step Three: Exposure Assessment
Step Four: Risk Characterization

Step One: Hazard Identification (Toxicology)

The first step in the risk assessment process is to identify potential health effects that may occur from different types of pesticide exposure. EPA considers the full spectrum of a pesticide's potential health effects.

Generally, for human health risk assessments, many toxicity studies are conducted on animals by pesticide companies in independent laboratories and evaluated for acceptability by EPA scientists. EPA evaluates pesticides for a wide range of adverse effects, from eye and skin irritation to cancer and birth defects in laboratory animals. EPA may also consult the public literature or other sources of supporting information on any aspect of the chemical.

Step Two: Dose-Response Assessment

Paracelsus, the Swiss physician and alchemist, the “father” of modern toxicology (1493-1541) said,

> "The dose makes the poison."

In other words, **the amount of a substance a person is exposed to** is as important as **how toxic the chemical might be**. For example, small doses of aspirin can be beneficial to people, but at very high doses, this common medicine can be deadly. In some individuals, even at very low doses, aspirin may be deadly.

Dose-response assessment involves considering the dose levels at which adverse effects were observed in test animals, and using these dose levels to calculate an equal dose in humans.

Step Three: Exposure Assessment

People can be exposed to pesticides in three ways:

1. Inhaling pesticides (inhalation exposure),
2. Absorbing pesticides through the skin (dermal exposure), and
3. Getting pesticides in their mouth or digestive tract (oral exposure).

Depending on the situation, pesticides could enter the body by any one or all of these routes. Typical sources of pesticide exposure include:

- **Food**
  Most of the foods we eat have been grown with the use of pesticides. Therefore, pesticide residues may be present inside or on the surfaces of these foods.

- **Home and Personal Use Pesticides**
  You might use pesticides in and around your home to control insects, weeds, mold, mildew, bacteria, lawn and garden pests and to protect your pets from pests such as fleas. Pesticides may also be used as insect repellants which are directly applied to the skin or clothing.

- **Pesticides in Drinking Water**
  Some pesticides that are applied to farmland or other land structures can make their way in small amounts to the ground water or surface water systems that feed drinking water supplies.

- **Worker Exposure to Pesticides**
  Pesticide applicators, vegetable and fruit pickers and others who work around pesticides can be exposed due to the nature of their jobs. To address the unique risks workers face from occupational exposure, EPA evaluates occupational exposure through a separate program. All pesticides registered by EPA have been shown to be safe when used properly.

Step Four: Risk Characterization

Risk characterization is the final step in assessing human health risks from pesticides. It is the process of combining the hazard, dose-response and exposure assessments to describe the overall risk from a pesticide. It explains the assumptions used in assessing exposure as well as the uncertainties that are built into the dose-response assessment. The strength of the overall database is considered, and broad conclusions are made. EPA’s role is to evaluate both toxicity and exposure and to determine the risk associated with use of the pesticide.

Simply put,

> RISK = TOXICITY x EXPOSURE.

This means that the risk to human health from pesticide exposure depends on both the toxicity of the pesticide and the likelihood of people coming into contact with it. At least *some* exposure and *some* toxicity are required to result in a risk. For example, if the pesticide is very poisonous, but no people are exposed, there is no risk. Likewise, if there is ample exposure but the chemical is non-toxic, there is no risk. However, usually when pesticides are used, there is some toxicity and exposure, which results in a potential risk.

EPA recognizes that effects vary between animals of different species and from person to person. To account for this variability, *uncertainty factors* are built into the risk assessment. These uncertainty factors create an additional margin of safety for protecting people who may be exposed to the pesticides. FQPA requires EPA to use an extra 10-fold safety factor, if necessary, to protect infants and children from effects of the pesticide.

Types of Toxicity Tests EPA Requires for Human Health Risk Assessments

EPA evaluates studies conducted over different periods of time and that measure specific types of effects. These tests are evaluated to screen for potential health effects in infants, children and adults.

Acute Testing: Short-term exposure; a single exposure (dose).

- Oral, dermal (skin), and inhalation exposure
- Eye irritation
- Skin irritation
- Skin sensitization
- Neurotoxicity

Sub-chronic Testing: Intermediate exposure; repeated exposure over a longer period of time (i.e., 30-90 days).

- Oral, dermal (skin), and inhalation
- Neurotoxicity (nerve system damage)

Chronic Toxicity Testing: Long-term exposure; repeated exposure lasting for most of the test animal's life span. Intended to determine the effects of a pesticide after prolonged and repeated exposures.

- Chronic effects (non-cancer)
- Carcinogenicity (cancer)

Developmental and Reproductive Testing: Identify effects in the fetus of an exposed pregnant female (birth defects) and how pesticide exposure affects the ability of a test animal to successfully reproduce.

Mutagenicity Testing: Assess a pesticide's potential to affect the cell's genetic components.

Hormone Disruption: Measure effects for their potential to disrupt the endocrine system. The endocrine system consists of a set of glands and the hormones they produce that help guide the development, growth, reproduction, and behavior of animals including humans.

Risk Management

Once EPA completes the risk assessment process for a pesticide, we use this information to determine if (when used according to label directions), there is a reasonable certainty that the pesticide will not harm a person’s health.

Using the conclusions of a risk assessment, EPA can then make a more informed decision regarding whether to approve a pesticide chemical or use, as proposed, or whether additional protective measures are necessary to limit occupational or non-occupational exposure to a pesticide. For example, EPA may prohibit a pesticide from being used on certain crops because consuming too much food treated with the pesticide may result in an unacceptable risk to consumers. Another example of protective measures is requiring workers to wear personal protective equipment (PPE) such as a respirator or chemical resistant gloves, or not allowing workers to enter treated crop fields until a specific period of time has passed.

If, after considering all appropriate risk reduction measures, the pesticide still does not meet EPA’s safety standard, the Agency will not allow the proposed chemical or use. Regardless of the specific measures enforced, EPA’s primary goal is to ensure that legal uses of the pesticide are protective of human health, especially the health of children, and the environment.

Human Health Risk Assessment and the Law

Federal law requires detailed evaluation of pesticides to protect human health and the environment. In 1996, Congress made significant changes to strengthen pesticide laws through the Food Quality Protection Act (FQPA). Many of these changes are key elements of the current risk assessment process. FQPA required that EPA consider:

- **A New Safety Standard**: FQPA strengthened the safety standard that pesticides must meet before being approved for use. EPA must ensure with a reasonable certainty that no harm will result from the legal uses of the pesticide.
- **Exposure from All Sources**: In evaluating a pesticide, EPA must estimate the combined risk from that pesticide from all non-occupational sources, such as:
    - Food Sources
    - Drinking Water Sources
    - Residential Sources
- **Cumulative Risk**: EPA is required to evaluate pesticides in light of similar toxic effects that different pesticides may share, or “a common mechanism of toxicity.” Read about how EPA evaluates cumulative risk for pesticides.
- **Special Sensitivity of Children to Pesticides**: EPA must ascertain whether there is an increased susceptibility from exposure to the pesticide to infants and children. EPA must build an additional 10-fold safety factor into risk assessments to ensure the protection of infants and children, unless it is determined that a lesser margin of safety will be safe for infants and children.

For More Information

If you would like more information about EPA's pesticide programs, contact the Communication Service Branch at (703) 305-5017 or visit the Pesticides Web site.

For more information on specific pesticides, or to inquire about the symptoms of pesticide poisoning, call the National Pesticide Information Center (NPIC), a toll-free hotline information at: 1-800-858-7378, or visit their Web site EXIT Disclaimer .

Español (https://www.atsdr.cdc.gov/es/index.html)

(https://atsdr.cdc.gov)

ATSDR Agency for Toxic Substances and Disease Registry

Substance Priority List

ATSDR's Substance Priority List

What is the Substance Priority List (SPL)?

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 104 (i), as amended by the Superfund Amendments and Reauthorization Act (SARA), requires ATSDR and the EPA to prepare a list, in order of priority, of substances that are most commonly found at facilities on the National Priorities List (NPL) and which are determined to pose the most significant potential threat to human health due to their known or suspected toxicity and potential for human exposure at these NPL sites. CERCLA also requires this list to be revised periodically to reflect additional information on hazardous substances. In CERCLA, it is called the priority list of hazardous substances that will be candidates for toxicological profiles.

2017 Substance Priority List

Click here to view the ATSDR 2017 Substance Priority List

This substance priority list is revised and published on a 2-year basis, with a yearly informal review and revision. (No list was published in 2009 while ATSDR transitioned to a new agency science database.) Each substance on the list is a candidate to become the subject of a toxicological profile prepared by ATSDR. The listing algorithm prioritizes substances based on frequency of occurrence at NPL sites, toxicity, and potential for human exposure to the substances found at NPL sites.

It should be noted that this priority list is not a list of "most toxic" substances, but rather a prioritization of substances based on a combination of their frequency, toxicity, and potential for human exposure at NPL sites.

Thus, it is possible for substances with low toxicity but high NPL frequency of occurrence and exposure to be on this priority list. The objective of this priority list is to rank substances across all NPL hazardous waste sites to provide guidance in selecting which substances will be the subject of toxicological profiles prepared by ATSDR.

Where can I find more information on the Substance Priority List?

Substantial additional information can be found on the SPL Resource page, including:

- Past Substance Priority Lists
- A Support Document describing the algorithm in detail
- A comprehensive SPL spreadsheet with data for all current and past lists, including candidate substances that did not make the top of the list

The ATSDR 2017 Substance Priority List

Hide/Show Table

2017 Rank	Substance Name	Total Points	CAS RN
1	ARSENIC	1674	7440-38-2
2	LEAD	1531	7439-92-1
3	MERCURY	1458	7439-97-6
4	VINYL CHLORIDE	1358	75-01-4
5	POLYCHLORINATED BIPHENYLS	1345	1336-36-3
6	BENZENE	1329	71-43-2
7	CADMIUM	1320	7440-43-9
8	BENZO(A)PYRENE	1306	50-32-8
9	POLYCYCLIC AROMATIC HYDROCARBONS	1279	130498-29-2
10	BENZO(B)FLUORANTHENE	1251	205-99-2
11	CHLOROFORM	1203	67-66-3
12	AROCLOR 1260	1191	11096-82-5
13	DDT, P,P'-	1183	50-29-3
14	AROCLOR 1254	1172	11097-69-1
15	DIBENZO(A,H)ANTHRACENE	1156	53-70-3
16	TRICHLOROETHYLENE	1155	79-01-6
17	CHROMIUM, HEXAVALENT	1148	18540-29-9
18	DIELDRIN	1144	60-57-1
19	PHOSPHORUS, WHITE	1141	7723-14-0
20	HEXACHLOROBUTADIENE	1130	87-68-3
21	DDE, P,P'-	1127	72-55-9
22	CHLORDANE	1126	57-74-9
23	AROCLOR 1242	1126	53469-21-9
24	COAL TAR CREOSOTE	1124	8001-58-9
25	ALDRIN	1116	309-00-2
26	DDD, P,P'-	1114	72-54-8
27	AROCLOR 1248	1105	12672-29-6
28	HEPTACHLOR	1102	76-44-8
29	AROCLOR	1101	12767-79-2

30	BENZIDINE	1093	92-87-5
31	ACROLEIN	1090	107-02-8
32	TOXAPHENE	1089	8001-35-2
33	TETRACHLOROETHYLENE	1078	127-18-4
34	HEXACHLOROCYCLOHEXANE, GAMMA-	1076	58-89-9
35	CYANIDE	1071	57-12-5
36	HEXACHLOROCYCLOHEXANE, BETA-	1054	319-85-7
37	DISULFOTON	1049	298-04-4
38	BENZO(A)ANTHRACENE	1047	56-55-3
39	1,2-DIBROMOETHANE	1043	106-93-4
40	ENDRIN	1039	72-20-8
41	DIAZINON	1038	333-41-5
42	HEXACHLOROCYCLOHEXANE, DELTA-	1036	319-86-8
43	BERYLLIUM	1031	7440-41-7
44	ENDOSULFAN	1029	115-29-7
45	AROCLOR 1221	1028	11104-28-2
46	1,2-DIBROMO-3-CHLOROPROPANE	1027	96-12-8
47	HEPTACHLOR EPOXIDE	1022	1024-57-3
48	ENDOSULFAN, ALPHA	1019	959-98-8
49	CIS-CHLORDANE	1017	5103-71-9
50	CARBON TETRACHLORIDE	1014	56-23-5
51	COBALT	1013	7440-48-4
52	AROCLOR 1016	1012	12674-11-2
53	DDT, O,P'-	1009	789-02-6
54	PENTACHLOROPHENOL	1008	87-86-5
55	METHOXYCHLOR	1007	72-43-5
56	ENDOSULFAN SULFATE	1005	1031-07-8
57	NICKEL	996	7440-02-0
58	DI-N-BUTYL PHTHALATE	995	84-74-2
59	ENDRIN KETONE	993	53494-70-5

60	DIBROMOCHLOROPROPANE	984	67708-83-2
61	BENZO(K)FLUORANTHENE	970	207-08-9
62	TRANS-CHLORDANE	969	5103-74-2
63	ENDOSULFAN, BETA	968	33213-65-9
64	CHLORPYRIFOS	965	2921-88-2
65	XYLENES, TOTAL	964	1330-20-7
66	CHROMIUM(VI) TRIOXIDE	961	1333-82-0
67	AROCLOR 1232	959	11141-16-5
68	ENDRIN ALDEHYDE	959	7421-93-4
69	METHANE	952	74-82-8
70	3,3′-DICHLOROBENZIDINE	942	91-94-1
71	2-HEXANONE	941	591-78-6
72	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	941	1746-01-6
73	BENZOFLUORANTHENE	937	56832-73-6
74	TOLUENE	917	108-88-3
75	ZINC	915	7440-66-6
76	PENTACHLOROBENZENE	907	608-93-5
77	DI(2-ETHYLHEXYL)PHTHALATE	906	117-81-7
78	CHROMIUM	895	7440-47-3
79	AROCLOR 1240	889	71328-89-7
80	2,4,6-TRINITROTOLUENE	879	118-96-7
81	NAPHTHALENE	877	91-20-3
82	1,1-DICHLOROETHENE	876	75-35-4
83	BROMODICHLOROETHANE	868	683-53-4
84	DDD, O,P’-	867	53-19-0
85	2,4,6-TRICHLOROPHENOL	867	88-06-2
86	BIS(2-CHLOROETHYL) ETHER	867	111-44-4
87	HYDRAZINE	862	302-01-2
88	METHYLENE CHLORIDE	860	75-09-2
89	2,4-DINITROPHENOL	859	51-28-5

90	4,4′-METHYLENEBIS(2-CHLOROANILINE)	859	101-14-4
91	1,2-DICHLOROETHANE	852	107-06-2
92	THIOCYANATE	847	302-04-5
93	HEXACHLOROBENZENE	844	118-74-1
94	ASBESTOS	841	1332-21-4
95	RDX (Cyclonite)	833	121-82-4
96	RADIUM-226	833	13982-63-3
97	URANIUM	832	7440-61-1
98	2,4-DINITROTOLUENE	832	121-14-2
99	ETHION	831	563-12-2
100	4,6-DINITRO-O-CRESOL	828	534-52-1
101	RADIUM	827	7440-14-4
102	THORIUM	824	7440-29-1
103	DIMETHYLARSINIC ACID	822	75-60-5
104	CHLORINE	821	7782-50-5
105	1,3,5-TRINITROBENZENE	820	99-35-4
106	RADON	818	10043-92-2
107	HEXACHLOROCYCLOHEXANE, ALPHA-	817	319-84-6
108	RADIUM-228	815	15262-20-1
109	THORIUM-230	813	14269-63-7
110	URANIUM-235	812	15117-96-1
111	THORIUM-228	810	14274-82-9
112	RADON-222	810	14859-67-7
113	URANIUM-234	809	13966-29-5
114	N-NITROSODI-N-PROPYLAMINE	808	621-64-7
115	COAL TARS	808	8007-45-2
116	METHYLMERCURY	808	22967-92-6
117	1,1,1-TRICHLOROETHANE	807	71-55-6
118	COPPER	807	7440-50-8
119	CHRYSOTILE ASBESTOS	806	12001-29-5

120	PLUTONIUM-239	806	15117-48-3
121	POLONIUM-210	805	13981-52-7
122	PLUTONIUM-238	805	13981-16-3
123	LEAD-210	805	14255-04-0
124	AMOSITE ASBESTOS	804	12172-73-5
124	PLUTONIUM	804	7440-07-5
124	STRONTIUM-90	804	10098-97-2
127	RADON-220	804	22481-48-7
128	CHLOROBENZENE	804	108-90-7
129	AMERICIUM-241	804	86954-36-1
130	HYDROGEN CYANIDE	803	74-90-8
131	AZINPHOS-METHYL	803	86-50-0
132	ETHYLBENZENE	802	100-41-4
133	CHLORDECONE	802	143-50-0
134	BARIUM	802	7440-39-3
135	NEPTUNIUM-237	802	13994-20-2
136	PLUTONIUM-240	801	14119-33-6
137	1,2,3-TRICHLOROBENZENE	801	87-61-6
138	FLUORANTHENE	800	206-44-0
139	S,S,S-TRIBUTYL PHOSPHOROTRITHIOATE	799	78-48-8
140	MANGANESE	798	7439-96-5
141	CHRYSENE	792	218-01-9
142	2,4,5-TRICHLOROPHENOL	792	95-95-4
143	PERFLUOROOCTANE SULFONIC ACID	788	1763-23-1
144	POLYBROMINATED BIPHENYLS	785	67774-32-7
145	DICOFOL	785	115-32-2
146	SELENIUM	776	7782-49-2
147	1,1,2,2-TETRACHLOROETHANE	776	79-34-5
148	PARATHION	774	56-38-2
149	HEPTACHLORODIBENZO-P-DIOXIN	774	37871-00-4

150	HEXACHLOROCYCLOHEXANE, TECHNICAL GRADE	774	608-73-1
151	TRICHLOROFLUOROETHANE	773	27154-33-2
152	BROMINE	771	7726-95-6
153	AROCLOR 1268	765	11100-14-4
154	1,3-BUTADIENE	762	106-99-0
155	PERFLUOROOCTANOIC ACID	758	335-67-1
156	HEPTACHLORODIBENZOFURAN	756	38998-75-3
157	TRIFLURALIN	755	1582-09-8
158	PERFLUOROHEXANESULFONIC ACID	749	355-46-4
159	1,2,3,4,6,7,8,9-OCTACHLORODIBENZOFURAN	743	39001-02-0
160	AMMONIA	742	7664-41-7
161	2-METHYLNAPHTHALENE	727	91-57-6
162	2,3,4,7,8-PENTACHLORODIBENZOFURAN	724	57117-31-4
163	1,4-DICHLOROBENZENE	724	106-46-7
164	1,1-DICHLOROETHANE	721	75-34-3
165	NALED	721	300-76-5
166	1,1,2-TRICHLOROETHANE	720	79-00-5
167	HEXACHLOROCYCLOPENTADIENE	719	77-47-4
168	1,2-DIPHENYLHYDRAZINE	718	122-66-7
169	PHORATE	716	298-02-2
170	TRICHLOROETHANE	713	25323-89-1
171	ACENAPHTHENE	710	83-32-9
172	TETRACHLOROBIPHENYL	710	26914-33-0
173	PALLADIUM	706	7440-05-3
174	OXYCHLORDANE	705	27304-13-8
175	CRESOL, PARA-	704	106-44-5
176	INDENO(1,2,3-CD)PYRENE	702	193-39-5
177	GAMMA-CHLORDENE	702	56641-38-4
178	TETRACHLOROPHENOL	699	25167-83-3
179	1,2-DICHLOROBENZENE	697	95-50-1

180	1,2-DICHLOROETHENE, TRANS-	691	156-60-5
181	CHLOROETHANE	687	75-00-3
182	P-XYLENE	687	106-42-3
183	ALUMINUM	687	7429-90-5
184	PHENOL	686	108-95-2
185	CARBON MONOXIDE	684	630-08-0
186	CARBON DISULFIDE	682	75-15-0
187	2,4-DIMETHYLPHENOL	680	105-67-9
188	DIBENZOFURAN	676	132-64-9
189	ACETONE	672	67-64-1
190	HEXACHLOROETHANE	671	67-72-1
191	BUTYL METHYL PHTHALATE	668	34006-76-3
192	CHLOROMETHANE	665	74-87-3
193	HEXACHLORODIBENZOFURAN	660	55684-94-1
194	BUTYL BENZYL PHTHALATE	658	85-68-7
195	HYDROGEN SULFIDE	658	7783-06-4
196	DICHLORVOS	656	62-73-7
197	DIBENZOFURANS, CHLORINATED	653	42934-53-2
198	CRESOL, ORTHO-	653	95-48-7
199	HEXACHLORODIBENZO-P-DIOXIN	652	34465-46-8
200	VANADIUM	650	7440-62-2
201	N-NITROSODIMETHYLAMINE	649	62-75-9
202	1,2,4-TRICHLOROBENZENE	647	120-82-1
203	PERFLUORONONANOIC ACID	647	375-95-1
204	ETHOPROP	644	13194-48-4
205	TETRACHLORODIBENZO-P-DIOXIN	641	41903-57-5
206	BROMOFORM	635	75-25-2
207	PENTACHLORODIBENZOFURAN	632	30402-15-4
208	1,3-DICHLOROBENZENE	628	541-73-1
209	PENTACHLORODIBENZO-P-DIOXIN	626	36088-22-9

210	N-NITROSODIPHENYLAMINE	625	86-30-6
211	2,4-DICHLOROPHENOL	619	120-83-2
212	2,3-DIMETHYLNAPHTHALENE	619	581-40-8
213	2,3,7,8-TETRACHLORODIBENZOFURAN	619	51207-31-9
214	1,4-DIOXANE	617	123-91-1
215	FLUORINE	613	7782-41-4
216	NITRITE	610	14797-65-0
217	CESIUM-137	610	10045-97-3
217	CHROMIC ACID	610	7738-94-5
219	2-BUTANONE	608	78-93-3
220	1,2-DICHLOROETHYLENE	608	540-59-0
221	POTASSIUM-40	608	13966-00-2
222	DINITROTOLUENE	607	25321-14-6
223	NITRATE	606	14797-55-8
224	FORMALDEHYDE	605	50-00-0
225	SILVER	605	7440-22-4
226	COAL TAR PITCH	605	65996-93-2
227	THORIUM-227	605	15623-47-9
228	ARSENIC ACID	604	7778-39-4
229	ARSENIC TRIOXIDE	604	1327-53-3
230	BENZOPYRENE	603	73467-76-2
231	CHLORDANE, TECHNICAL	602	12789-03-6
232	STROBANE	602	8001-50-1
233	4-AMINOBIPHENYL	602	92-67-1
233	PYRETHRUM	602	8003-34-7
235	ARSINE	602	7784-42-1
235	DIMETHOATE	602	60-51-5
237	BIS(CHLOROMETHYL) ETHER	602	542-88-1
237	CARBOPHENOTHION	602	786-19-6
239	ALPHA-CHLORDENE	601	56534-02-2

239	IODINE-131	601	10043-66-0
239	MERCURIC CHLORIDE	601	7487-94-7
239	SODIUM ARSENITE	601	7784-46-5
239	URANIUM-233	601	13968-55-3
244	ANTIMONY	601	7440-36-0
245	DIBROMOCHLOROMETHANE	601	124-48-1
246	CRESOLS	598	1319-77-3
247	DICHLOROBENZENE	596	25321-22-6
248	2,4-D	595	94-75-7
249	2-CHLOROPHENOL	591	95-57-8
250	BUTYLATE	591	2008-41-5
251	DIMETHYL FORMAMIDE	585	68-12-2
252	PHENANTHRENE	585	85-01-8
253	4-NITROPHENOL	580	100-02-7
254	DIURON	580	330-54-1
255	TETRACHLOROETHANE	577	25322-20-7
256	DICHLOROETHANE	568	1300-21-6
257	ETHYL ETHER	566	60-29-7
258	DIMETHYLANILINE	563	121-69-7
259	1,3-DICHLOROPROPENE, CIS-	561	10061-01-5
260	PYRENE	561	129-00-0
261	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	559	35822-46-9
262	PHOSPHINE	557	7803-51-2
263	TRICHLOROBENZENE	556	12002-48-1
264	2,6-DINITROTOLUENE	555	606-20-2
265	FLUORIDE ION	550	16984-48-8
266	PENTAERYTHRITOL TETRANITRATE	549	78-11-5
267	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	549	67562-39-4
268	1,3-DICHLOROPROPENE, TRANS-	548	10061-02-6
269	ACRYLONITRILE	544	107-13-1

270	BIS(2-ETHYLHEXYL)ADIPATE	543	103-23-1
271	CARBAZOLE	541	86-74-8
272	2-CHLOROANILINE	539	95-51-2
273	METOLACHLOR	539	51218-45-2
274	1,2-DICHLOROETHENE, CIS-	539	156-59-2
275	1,2,3-TRICHLOROPROPANE	537	96-18-4

Substances were assigned the same rank when two (or more) substances received equivalent total point scores.

CAS RN= Chemical Abstracts Service Registry Number

Top of Page

Contact Information

Further information can be obtained by contacting the ATSDR Information Center at:

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences
1600 Clifton Road NE, Mailstop F-57
Atlanta, GA 30329
Phone: 1-800-CDC-INFO 888-232-6348 (TTY)
Email: Contact CDC-INFO (https://www.cdc.gov/cdc-info/requestform.html)

Page last reviewed: August 10, 2017

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC
231 West 29th Street, Suite 1104
New York, New York 10001 USA
Tel: (631) 462-5866
Email: Info@hydrotechenvironmental.com
WWW.HYDROTECHENVIRONMENTAL.COM
USA – Middle East – North Africa

Accident / Incident Reporting Log

Unit:	Chartering Organization:

INFORMATION ON PERSON IN CHARGE OF THE GROUP

Name:

Address:

Phone numbers:	Home:	Work:
	Fax:	E-Mail:

INFORMATION ON THE INCIDENT

Nature of the activity:

Place of the activity:

Date of the incident:	Time of the incident:

Exact location of the incident:

Weather Conditions (if applicable):

Name of Person in charge at the time:

Description of incident (if machinery involved, list owner and operator and details on incident)

Witness Name:	Home Phone:	Work Phone:
Witness Name:	Home Phone:	Work Phone:

COMPLETE ONLY IF THIS INCIDENT WAS REPORTED TO THE NYPD or FDNY

Station Name, Number:

Station Address:

Name and Phone Number of Officer in Charge:

INFORMATION ON INJURED PERSON OR OWNER OF DAMAGED PROPERTY		
Name:		Birth date:
Address:		
Phone Numbers:	Home:	Work:
Please describe nature of injury or property damage		
Complete if applicable:	Name of doctor consulted:	Phone:
Complete if applicable:	Name and address of hospital or clinic:	Phone:
REPORTING DETAILS		
This report must be signed by person in charge of Site Operations at time of incident including Site Supervisor, or Project Manager or Site Safety officer	Print full name:	
	Position:	
	Street Address:	
	Town, State, Zip:	
	Telephone (Home)	(work)
	Fax:	Email:
	Signature:	Date:

APPENDIX B: CAMP

COMMUNITY AIR MONITORING PLAN (CAMP)

601 – 607 Union Street

Block 434, Lots 1 and 12

Brooklyn, New York

1. Introduction

The Community Air Monitoring Plan (CAMP) has been prepared to monitor the air quality during the intrusive activities proposed as a part of the Remedial Investigation (RI) activities at the property located at 601 – 607 Union Street in Gowanus section of Brooklyn, NY. Levels of VOCs and dust in the air will be monitored continuously and periodically utilizing a Photo Ionization Detector (PID) and Real-Time Particulate Dust Tracker, respectively. For this investigation, the PID will be calibrated at the beginning of each day to the compound isobutylene, which is published by the manufacturer. The PID has a minimum detection limit of 0.1 parts per million (ppm). The Dust Tracker provides real-time measurement based on 90° light scattering. The Dust Tracker has a minimum detection limit of 0.001 mg/m^3.

Continuous real-time air monitoring for VOCs and particulate levels at the perimeter of the exclusion zone or work area will be performed for all ground intrusive activities. Ground intrusive activities include but are not limited to the installation of soil borings, monitoring wells and soil vapor probes.

Periodic monitoring for VOCs will be performed during non-intrusive activities such as the collection of soil samples, the collection of groundwater samples from monitoring wells. For instance, periodic monitoring during sample collection will consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location. Depending upon the proximity of potentially exposed individuals, continuous monitoring may be performed during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence. Exceedances of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the NYSDEC and recorded in a field daily log. A summary of daily logs/reports will be provided in the Remedial Investigation Report (RIR).

2. VOCs Monitoring, Response Levels and Actions

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during invasive work. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a PID, which will be calibrated at least daily for to the compound isobutylene. The PID will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200-feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20-feet - is below 5 ppm over background for the 15-minute average.

Activities will be shut down if the organic vapor level at the perimeter of the work area is above 25 ppm.

All 15-minute readings must be recorded in a daily field log. Instantaneous readings, if any, used for decision purposes will also be recorded.

3. PM Monitoring, Response Levels And Actions

Particulate concentrations will be monitored continuously at the downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using a Dust Tracker 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 should be visually assessed during all work activities.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels are not 150 mcg/m^3 or greater above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are 150 mcg/m^3 or greater above the upwind level, work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration. All readings will be recorded in a daily field log.

APPENDIX C: SAMPLE BORING LOG

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC
231 West 29th Street, Suite 1104
New York, New York 10001 USA
Tel: (631) 462-5866
Email: Info@hydrotechenvironmental.com
WWW.HYDROTECHENVIRONMENTAL.COM
USA – Middle East – North Africa

Soil Probe Log

Job No: xxxxxx

Date: xx/xx/xxxx

Page: 1 of 1

Location: ABCD, EF, GH

Sampling Interval: 2 feet

Boring No.: SP-x

Sampling Method: Grab

Drilling Method: Direct Push

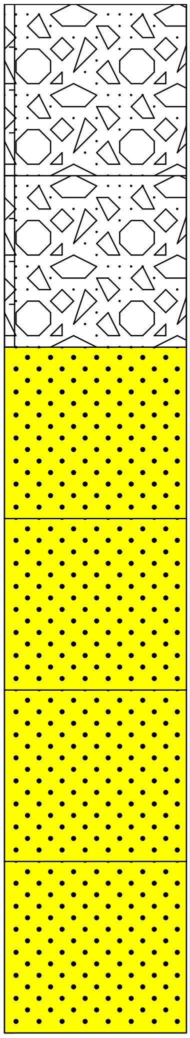
Driller:

Total Depth: 12 feet

Depth to Water:

USCS SYMBOLS

GW - Well Graded Gravel
GP - Poorly Graded Gravel
GM - Silty Gravel
GC - Clayey Gravel
SW - Well Graded Sand
SP - Poorly Graded Sand
SM - Silty Sand
SC - Clayey Sand
ML - Inorganic Silt / Sandy Silt
CL - Inorganic Clays/Sandy Clay
OL - Inorganic Silts/Organic Silty Clay
MH- Elastic Silts
CH - Inorganic Clay, High Plastic
OH - Organic Silt / Clay
PT - Peat/High Organics



Depth Below Grade and Lithology	PID Reading (ppm)	USCS	Soil Description
0	0.0	SP	concrete/dark brown, med grained sandy loam with brick and pebble sized clasts
-2	0.0	SP	dark brown, med grained sandy loam with brick and pebble sized clasts
-4	0.0	SP	brown, med grained sand
-6	0.0	SP	brown, med grained sand
-8	0.0	SP	brown, med grained sand
-10	0.0	SP	brown, med grained sand
-12			

APPENDIX D: SAMPLE WELL CONSTRUCTION LOG

HYDRO TECH ENVIRONMENTAL CORP.

MAIN OFFICE:
2171 JERICHO TURNPIKE, SUITE 345
COMMACK, NEW YORK 11725

NYC OFFICE:
1111 FULTON STREET, SECOND FLOOR
BROOKLYN, NEW YORK 11238

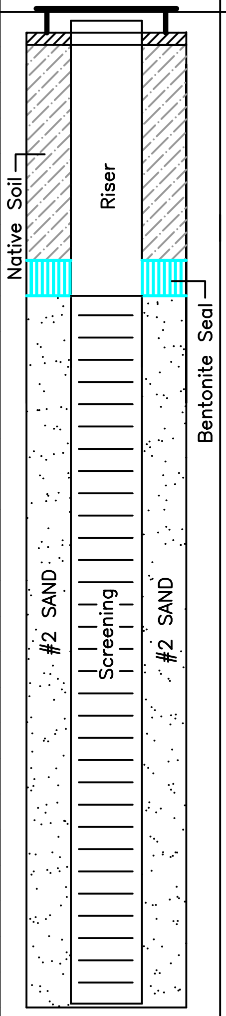
PHONE: (631) 462-5866 FAX: (631) 462-5877

WELL CONSTRUCTION LOG

Job No:
Date:
Page: 1 OF 1

Location:

Well Number:	MW-1	Screen Size:	0.010"
Drilling Method:	DIRECT PUSH	Screen Interval:	20.00'
Total Depth:	28'	Diameter:	1"
Depth to Water:	14.71"	Riser Length:	8'
Manhole Size:	5"	Sand Size:	#2

Depth Below Grade (ft.)	Sample Interval (ft.)	Well Construction	Description
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36			5" Manhole Cover 0' – 7.00' – Native Soil 7' – 8.00' – Bentonite Seal 8' – 28.00' – #2 Sand 0' – 8.00' – Riser 8' – 28.00' – Screen

APPENDIX E: QAPP

QUALITY ASSURANCE PROJECT PLAN

601 – 607 Union Street
Block 434, Lots 1 and 12
Brooklyn, New York

Table of Contents

Tables

Attachments

1.0 Introduction

This Quality Assurance Project Plan (QAPP) has been prepared for the samples to be collected in accordance with the Remedial Investigation Work Plan (RIWP) developed for the property located at 601 – 607 Union Street in Brooklyn, NY. The intent of the QAPP is to ensure that (1) proper equipment handling and maintenance is followed, (2) cross-contamination between sampling locations does not occur, (3) standard number of quality control replicate environmental samples are obtained, (4) proper procedures for samples custody are performed and (5) data review, validation and verification requirements are complete.

All related portions of the fieldwork will be performed, at a minimum, in accordance with acceptable industry standards. These acceptable industry standards include, but are not limited to, the ASTM Standard Guide for Phase II Environmental Site Assessments (E 1903-97) and the New York State Department of Environmental Conservation (NYSDEC) Bureau of Spill Prevention & Response Sampling Guidelines and Protocols, March 1991 and NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation, May 2010, 6 NYCRR Subpart 360.

2.0 Project Objective and Scope of Work

The objective of the investigation as set forth in the RIWP is to characterize the vertical and horizontal delineation of contamination beneath the Site and determine the groundwater flow beneath the Site. This investigation will be performed in accordance to the New York State Department of Environmental Conservation (NYSDEC) requirements under the NYS Brownfield Cleanup Program (BCP) and in compliance with the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (May 2010), New York State Department of Health (NYSDOH) Guidance for evaluating Soil Vapor Intrusion in the State of NY (October 2006) and other acceptable industry standards.

To meet the above objectives a total of seven (7) soil probes, three (3) temporary monitoring wells and three (3) sub-slab vapor probes will be installed and sampled during this investigation. Soil boring and monitoring well installation, construction, and development shall conform to NYCRR Part 360.

3.0 Sampling Procedures, Decontamination Methods and Data Quality Usability Objectives

3.1 Soil Sampling

Soil samples will be collected from seven (7) soil borings designated as SP-18 through SP-24. All soil samples will be obtained at 2-foot intervals utilizing a 4-foot or 5-foot long Macro Core sampler fitted with dedicated acetate liners. The location of the soil probes is provided in **Figure 7** of the RIWP.

At minimum two (2) soil samples will be collected from each of the soil probes for lab analysis and will consist of the 2-foot interval below surface grade and the 2-foot sample above groundwater table. A third sample will be collected if it exhibits a considerable level of hydrocarbons based upon the field screening results or will be collected from the historic fill layer if fill material was not intercepted in any of the prior two samples.

Each soil sample will be placed directly into pre-cleaned containers provided by the laboratory samples from select soil probes. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 1** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for soil samples.

3.2 Groundwater Sampling

Groundwater samples will be obtained from the three (3) temporary monitoring wells designated as MW-9 to MW-11 that will be installed during the investigation. Groundwater samples will be collected utilizing a low flow pump fitted with dedicated polyethylene tubing. Initially, each monitoring well will be purged prior to sampling. Purging and sampling of the monitoring wells will be conducted according USEPA's Region 1 Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells (EQASOP #GW4, Rev. September 19, 2017) utilizing a portable water quality meter YSI-6820, which utilizes an in-line flow cell for water quality indicator measurements (the USEPA's Region 1 Low-Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells guidance is provided in Attachment A). Groundwater will be purged at a low flow rate of less than 500 milliliter per minute (mL/min) until water quality indicator parameters including pH, temperature, specific conductivity, oxidation reduction potential, dissolved oxygen and turbidity are stabilized within the specified confidence limits for three consecutive readings:

- pH (±1 unit),
- Dissolved Oxygen (10% for values exceeding 5 mg/L or considered stabilized if less than 5 mg/L),
- Specific Conductance (3%),
- ORP (±10 millivolts),

- Temperature (3%), and
- Turbidity (10% for values exceeding 5 NTU or considered stabilized if less than 5 NTU).

During this low flow sampling from each monitoring well, the use of any equipment, materials or sampling jars that are known to contain Perfluorinated Compounds (PFCs) or polytetrafluoroethylene (PTFE) such as teflon tubing, low density polyethylene (LDPE) tubing or sample bottle cap liners should be prevented. Besides any contact with PFC waterproofed cloths or PFC containing materials such as aluminum foils and many food and drink packaging materials and should be avoided (Attachment B provides sampling guidelines and protocols for FPOA).

The sampling of each well will be performed once groundwater purging is completed. Attachment C provides a sample Groundwater Sampling/Purge Log. The location of the monitoring wells is provided in **Figure 7** of the RIWP.

Each groundwater sample will be placed directly into pre-cleaned containers provided by the laboratory. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Sample containers will be labeled and placed in a cooler filled with ice and maintained at 4 degrees Celsius. Each sample will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 2** provides the sample containers, volumes, test methods, preservation techniques, reporting limits and holding times for the groundwater samples.

3.3 Soil vapor sampling points

Three (3) sub-slab vapor probes designated as SSB-6 and SSB-8 will be sampled utilizing in accordance with the New York State Department of Health (NYSDOH) Guidance for Evaluating Soil Vapor Intrusion in the State of New York October 2006. Soil vapor samples will be collected utilizing 6 liter pre-cleaned, passivated, and evacuated whole air Summa® Canister. A 60-cm^3 plastic syringe will be used to purge approximately 1 to 3 implant volumes (i.e. the volume of the sample probe and tube) prior to collecting the soil vapor samples. Each air sampling canister will then be connected to a flow control valve set to collect the 6-L sample over a period of 4 hours at a rate of less than 0.2 liter per minute.

The vapor samples will be transmitted under proper chain of custody procedures to a NYSDOH ELAP-certified laboratory for analysis. **Table 3** provides the sample containers, volumes, test methods, reporting limits and holding times for the soil vapor samples. The location of the soil vapor sampling location is provided in **Figure 7** of the RIWP.

3.4 Decontamination Procedures

During the field sampling, Ruijie Xu, who is a Project Manager (PM) and also the Quality Assurance Officer (QAO) at HydroTech Environmental Engineering and Geology, DPC will be responsible for monitoring the decontamination procedure of every piece of sampling equipment prior to each use by field personnel. The following procedure will be implemented during the decontamination process:

- Wipe clean and wash with Alconox®
- Potable water rinse
- Methanol rinse
- Deionized water rinse
- Air dry

All decontamination procedures will be performed in an area segregated from any sampling areas. Any rinsate from the decontamination area will be contained and placed in 55-gallons drums and properly disposed of.

3.5 Quality Assurance and Quality Control (QA/QC)

The following Quality Assurance (QA) and Quality Control (QC) samples will also be collected and analyzed.

- One trip blank per trip will be analyzed via EPA Method 8260
- One field blank (rinsate blank) for soil will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010 and EPA Method 7471 and also for EPA Method 8270D SIM and Modified EPA Method 537M.
- One field blank (rinsate blank) for groundwater will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010, EPA Method 7471 and also EPA Method 8270D SIM and Modified EPA Method 537M.

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) samples will also be collected and analyzed.

- One MS soil sample and one MSD soil sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010 and EPA Method 7471, and also for EPA Method 8270 and EPA Method 537M.
- One MS groundwater sample and one MSD groundwater sample will be analyzed via EPA Method 8260, EPA Method 8270, EPA Method 8081, EPA Method 8151, EPA Method 8082, EPA Method 6010, EPA Method 7471 and also EPA Method 8270D SIM and Modified EPA Method 537M.

Tables 1, Table 2 and Table 3 provide the sampling and analytical Method Requirements along with a summary of anticipated QA/QC for soil, groundwater and vapor/air.

3.6 General QA/QC Considerations

The soil and groundwater samples and the soil vapor samples will be managed as per the following protocols:

- HydroTech PM and QAO (Ruijie Xu) shall perform field audits to verify compliance with the RIWP and identify corrective measures where problems are identified. A resume for Ruijie Xu is included in **Attachment D**
- Samples will be labeled and logged in a monitor notebook and Chain of Custody upon collection including sampler name, sampling identification, date and time of sample collection and sampling depth, sampling methods and devices.
- In the field, samples will be the responsibility of, and will stay with, the HydroTech field geologist (Ruijie Xu).
- Once samples have been collected, they are returned to HydroTech office and logged in for temporary storage under a proper Chain of Custody. **Attachment E** provides a sample chain of custody form.
- Soil samples will be refrigerated to maintain a temperature at a maximum 4 degrees Celsius.
- HydroTech staff will be then responsible for transporting samples to State-certified (ELAP) laboratory for analysis under a proper Chain of Custody.
- Laboratory personnel will record the date and time of samples arrival at the lab and ensure that all holding times for each matrix and analysis will be met.
- After samples are analyzed, laboratory information is added to the label.
- The Sample Chain of Custody form will be used to record all transport and storage information.
- Samples analytical data report will undergo QA/QC performed by a laboratory QA officer who checks each data sheet for precision, missing or illegible information, errors in calculation and values outside of the expected range. A minimum of five percent of the total of a given type of sample shall be devoted to internal QC checks. These checks are designed to ensure accuracy in the sampling procedure and the analytical methods and include blanks, duplicates, matrix spikes reference standards and performance evaluation samples. **Attachment F** provides a conventional lab QA/QC procedures associated with soil samples and analysis.
- The Laboratory data packages will conform to the Analytical Services Protocols (ASP) Category B Deliverables in accordance to NYSDEC DER-10 Appendix 2B.
- To ensure that data quality objectives are met, HydroTech QAO will assess data precision, accuracy, degree of representation, comparability and completeness of samples and data. This is primarily accomplished in the evaluation of data

together with field notes and sampling logs. In order to ensure that cross-contamination between sampling locations did not occur, each piece of detection and reporting limits shall allow for comparison with soil quality standards.

- All deficiencies identified by HydroTech PM during the performance of field audits or evaluation of the data will be immediately reported to the field Geologist, and the NYSDEC. In addition to identifying deficiencies, the HydroTech PM is responsible for recommending corrective actions.
- The analytical data generated from this project will be provided in an electronic format in accordance with NYSDECs DER-10 Section 1.15. Specifically, the final reports shall be in an electronic format that complies with the NYSDEC's Electronic Document Standards (EDS).
- A Category B deliverable is required and a Data Usability Summary Report (DUSR) will be prepared. The DUSR will include all data and answer the following questions:
    1. Is the data package complete as defined under the requirements for the most current DEC ASP Category B or USEPA CLP data deliverables?
    2. Have all holding times been met?
    3. Do all the QC data; blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
    4. Have all of the data been generated using established and agreed upon analytical protocols?
    5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?
    6. Have the correct data qualifiers been used and are they consistent with the most current DEC ASP?
    7. Have any quality control (QC) exceedances been specifically noted in the DUSR and have the corresponding QC summary sheets from the data package been attached to the DUSR?
- All validated data will be reviewed by Hanibal C. Tayeh, an independent QAO of the laboratory who is responsible of generating a data usability analysis. This analysis shall consist of (1) an assessment to determine if the data quality objectives were met; (2) evaluation of field duplicate results to indicate the samples are representative; (3) comparison of the results of trip blanks and methods blanks with full data sets to provide information concerning contaminants that may have been introduced during sampling, shipping or analyzing; (4) evaluation of matrix effects to assess the performance of the analytical method with respect to sample matrix, and determine whether the data have been biased high or low due to matrix effects. A Data Usability Summary Report (DUSR) will be prepared and provided in an electronic format

in accordance to NYSDEC DER-10 Appendix 2B and in compliance with the NYSDEC's Electronic Document Standards (EDS). A resume for Hanibal C. Tayeh is included in **Attachment D.**

- Field investigation will be performed under the full oversight of Tarek Z. Khouri, a NYS registered professional engineer. A resume for Tarek Z. Khouri is included in **Attachment D**.

TABLES

Table 1: Sampling & Analytical Method Requirements – Soil Samples

Soil Matrix(1) Sample ID	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
SP-18 – SP-24 & Matrix Spike/Matrix Spike Duplicate	TCL VOCs	120 ml + 2 oz	2 oz. clear wide-mouth glass with Teflon lined septum + 40 ml methanol vial with Teflon lined cap + 40 ml DI water vial with Teflon lined cap + 40 ml unpreserved vial with Teflon lined cap	Cool to 4 °C(2)	EPA Method 8260	Compound Specific (0.001-0.05 mg/Kg)	14 days
	TCL SVOCs	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 8270	Compound Specific (0.065-0.250 mg/Kg)	14 days
	TAL Metals	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 6010/EPA 7470 for Mercury	Compound Specific (0.05-10 mg/Kg)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Methods 8082/8151	Compound Specific (0.005-0.02 mg/Kg)	14 days
	PCBs	8 oz	8 oz. clear wide-mouth glass with Teflon lined septum	Cool to 4 °C	EPA Method 8081	Compound Specific (0.025 mg/Kg)	14 days
	1,4-Dioxane	500 mL	4 oz. clear glass	Cool 4°C	EPA Method 8270D SIM	0.1 mg/Kg	14 days
	21 Target PFOAs	5g	40 ml VOC vial + Bisulfate	Cool 4°C	Modified EPA Method 537M	0.001 mg/Kg	14 days
Field Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days
	TCL SVOCs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270	Compound Specific (2-20 µg/L)	7 days
	TAL Metals	500 ml	500 ml Poly cup with Teflon lined cap	HNO_3 to pH<2 Cool to 4 °C	EPA Method 6010/EPA 7470 for Mercury	Compound Specific (2-20 µg/L)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Methods 8082/8151	Compound Specific (0.01-0.1 µg/L)	7 days
	PCBs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8081	Compound Specific (0.05 µg/L)	7 days
	1,4-Dioxane	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270D SIM	Compound Specific (≤0.35 µg/L)	7 days
	21 Target PFOAs	500	500 ml HDPE or polypropylene	Cool to 4 °C	Modified EPA Method 537	Compound Specific (≤2 ng/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days

(1)…Analytical Services Protocols (ASP) Deliverables Package Category B.

(2)…If samples are not delivered to the lab with 48 hours after collection, the 40 ml DI Water vials should be preserved in a frozen condition following sampling

Table 2: Sampling & Analytical Method Requirements – Groundwater Samples

Groundwater Matrix(1) Sample ID	Parameters	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
MW-9 to MW-11 & Matrix Spike /Matrix Spike Duplicate & & Field Blank	TCL VOCs	120 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.2-10 µg/L)	14 days
	TCL SVOCs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270	Compound Specific (2-20 µg/L)	7 days
	TAL Metals	500 ml	500 ml Poly cup with Teflon lined cap	HNO_3 to pH<2 Cool to 4 °C	EPA Method 6010/EPA 7470 for Mercury	Compound Specific (2-20 µg/L)	6 months/ Chromium Hexavalent 24 hours/Mercury 28 days
	Herbicides/ Pesticides	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Methods 8082/8151	Compound Specific (0.01-0.1 µg/L)	7 days
	PCBs	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8081	Compound Specific (0.05 µg/L)	7 days
	1,4 Dioxane	1 liter	1 Liter amber glass with Teflon lined cap	Cool to 4 °C	EPA Method 8270D SIM	Compound Specific (≤0.28 µg/L)	7 days
	Perfluorooctanoic acid (PFOA) and other perfluorinated compounds (PFCs)	500 ml	500 ml HDPE or polypropylene	Cool to 4 °C	Modified EPA Method 537	Compound Specific (≤2 ng/L)	14 days
Trip Blank	TCL VOCs	80 ml	40 ml VOC vial with Teflon lined cap	1:1 HCl to pH<2 Cool to 4 °C	EPA Method 8260	Compound Specific (0.5-20 µg/L)	14 days

(1)…Analytical Services Protocols (ASP) Deliverables Package Category B.

Table 3: Sampling & Analytical Method Requirements – Vapor/Air Samples

Vapor/Air Matrix	Parameters	No. of Samples	Minimum Sample Volume	Sample Container	Sample Preservation	Analytical Method	Lab Reporting Limit	Technical Holding Time
Sample ID								
SSB-6 through SSB-8	VOCs	3	6 L	Summa® Canister	NA	TO-15	Compound Specific (1-20 µg/m^3)	30 days

ATTACHMENT A

USEPA LOW FLOW SAMPLING PROTOCOL

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency – Region 1
11 Technology Drive
North Chelmsford, MA 01863

The controlled version of this document is the electronic version viewed on-line only. If this is a printed copy of the document, it is an uncontrolled version and may or may not be the version currently in use.

This document contains direction developed solely to provide guidance to U.S. Environmental Protection Agency (EPA) personnel. EPA retains the discretion to adopt approaches that differ from these procedures on a case-by-case basis. The procedures set forth do not create any rights, substantive or procedural, enforceable at law by party to litigation with EPA or the United States.

Prepared by:___________________________________ ____________
(Robert Reinhart, Quality Assurance Unit) Date

Approved by:___________________________________ ____________
(John Smaldone, Quality Assurance Unit) Date

Revision Page

Date	**Rev #**	**Summary of changes**	**Sections**
7/30/96	1	Finalized	
01/19/10	2	Updated	All sections
3/23/17	3	Updated	All sections
9/20/17	4	Updated	Section 7.0

Table of Contents

1.0 USE OF TERMS

Equipment blank: The equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank needs only to include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Field duplicates: Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

Indicator field parameters: This SOP uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of when purging operations are sufficient and sample collection may begin.

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program. Consult the laboratory for the sample volume to be collected.

Potentiometric Surface: The level to which water rises in a tightly cased well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

QAPP: Quality Assurance Project Plan

SAP: Sampling and Analysis Plan

SOP: Standard operating procedure

Stabilization: A condition that is achieved when all indicator field parameter measurements are sufficiently stable (as described in the “Monitoring Indicator Field Parameters” section) to allow sample collection to begin.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site and returned to the laboratory. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

2.0 SCOPE & APPLICATION

The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This standard operating procedure (SOP) for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

The SOP emphasizes the need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging in order to determine when sample collection may begin. Samples properly collected using this SOP are suitable for analysis of groundwater contaminants (volatile and semi-volatile organic analytes, dissolved gases, pesticides, PCBs, metals and other inorganics), or naturally occurring analytes. This SOP is based on Puls, and Barcelona (1996).

This procedure is designed for monitoring wells with an inside diameter (1.5-inches or greater) that can accommodate a positive lift pump with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval"). This SOP is not applicable to other well-sampling conditions.

While the use of dedicated sampling equipment is not mandatory, dedicated pumps and tubing can reduce sampling costs significantly by streamlining sampling activities and thereby reducing the overall field costs.

The goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help to minimize sampling variability.

This procedure describes a general framework for groundwater sampling. Other site specific information (hydrogeological context, conceptual site model (CSM), DQOs, etc.) coupled with systematic planning must be added to the procedure in order to develop an appropriate site specific SAP/QAPP. In addition, the site specific SAP/QAPP must identify the specific equipment that will be used to collect the groundwater samples.

This procedure does not address the collection of water or free product samples from wells containing free phase LNAPLs and/or DNAPLs (light or dense non-aqueous phase liquids). For this type of situation, the reader may wish to check: Cohen, and Mercer (1993) or other pertinent documents.

This SOP is to be used when collecting groundwater samples from monitoring wells at all Superfund, Federal Facility and RCRA sites in Region 1 under the conditions described herein. Request for modification of this SOP, in order to better address specific situations at individual wells, must include adequate technical justification for proposed changes. All changes and modifications must be approved and included in a revised SAP/QAPP before implementation in field.

3.0 BACKGROUND FOR IMPLEMENTATION

It is expected that the monitoring well screen has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, and operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake. For new wells, or for wells without pump intake depth information, the site’s SAP/QAPP must provide clear reasons and instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected. If the depths to top and bottom of the well screen are not known, the SAP/QAPP will need to describe how the sampling depth will be determined and how the data can be used.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU, and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the indicator field parameter criteria in this procedure are met. If after 2 hours of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization), c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore, the data may not meet the data quality objectives of the sampling event).

It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell needs to be used to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

4.0 HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

5.0 CAUTIONS

The following cautions need to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture along the sampling tubing, and squeezing/pinching the pump's tubing which results in a pressure change.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem when using a centrifugal pump or peristaltic pump.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., dissolved oxygen meter, etc.) can result in faulty data being collected.

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby).

Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely checked to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exist) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be needed.

6.0 PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. OSHA regulations may require the sampler to take the 40 hour OSHA health and safety training course and a refresher course prior to engaging in any field activities, depending upon the site and field conditions.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with, the site Health and Safety Plan, all relevant SOPs, and SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

7.0 EQUIPMENT AND SUPPLIES

A. Informational materials for sampling event

A copy of the current Health and Safety Plan, SAP/QAPP, monitoring well construction data, location map(s), field data from last sampling event, manuals for sampling, and the monitoring instruments' operation, maintenance, and calibration manuals should be brought to the site.

B. Well keys.

C. Extraction device

Adjustable rate, submersible pumps (e.g., centrifugal, bladder, etc.) which are constructed of stainless steel or polytetrafluoroethylene (PTFE, i.e. Teflon®) are preferred. PTFE, however, should not be used when sampling for per- and polyfluoroalkyl substances (PFAS) as it is likely to contain these substances.

Note: If extraction devices constructed of other materials are to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

If bladder pumps are selected for the collection of VOCs and dissolved gases, the pump setting should be set so that one pulse will deliver a water volume that is sufficient to fill a 40 mL VOC vial. This is not mandatory, but is considered a "best practice". For the proper operation, the bladder pump will need a minimum amount of water above the pump; consult the manufacturer for the recommended submergence. The pump's recommended submergence value should be determined during the planning stage, since it may influence well construction and placement of dedicated pumps where water-level fluctuations are significant.

Adjustable rate, peristaltic pumps (suction) are to be used with caution when collecting samples for VOCs and dissolved gases (e.g., methane, carbon dioxide, etc.) analyses. Additional information on the use of peristaltic pumps can be found in Appendix A.
If peristaltic pumps are used, the inside diameter of the rotor head tubing needs to match the inside diameter of the tubing installed in the monitoring well.

Inertial pumping devices (motor driven or manual) are not recommended. These devices frequently cause greater disturbance during purging and sampling, and are less easily controlled than submersible pumps (potentially increasing turbidity and sampling variability, etc.). This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

D. Tubing

PTFE (Teflon®) or PTFE-lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. As discussed in the previous section, PTFE tubing should not be used when sampling for PFAS. In this case, a suitable alternative such as high-density polyethylene tubing should be used.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for metal and other inorganics analyses.

Note: If tubing constructed of other materials is to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

The use of 1/4 inch or 3/8 inch (inside diameter) tubing is recommended. This will help ensure that the tubing remains liquid filled when operating at very low pumping rates when using centrifugal and peristaltic pumps.

Silastic tubing should be used for the section around the rotor head of a peristaltic pump. It should be less than a foot in length. The inside diameter of the tubing used at the pump rotor head must be the same as the inside diameter of tubing placed in the well. A tubing connector is used to connect the pump rotor head tubing to the well tubing. Alternatively, the two pieces of tubing can be connected to each other by placing the one end of the tubing inside the end of the other tubing. The tubing must not be reused.

E. The water level measuring device

Electronic ”tape”, pressure transducer, water level sounder/level indicator, etc. should be capable of measuring to 0.01 foot accuracy. Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level “tape” at the start and end of each sampling event.

F. Flow measurement supplies

Graduated cylinder (size according to flow rate) and stopwatch usually will suffice.

Large graduated bucket used to record total water purged from the well.

G. Interface probe

To be used to check on the presence of free phase liquids (LNAPL, or DNAPL) before purging begins (as needed).

H. Power source (generator, nitrogen tank, battery, etc.)

When a gasoline generator is used, locate it downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate samples.

I. Indicator field parameter monitoring instruments

Use of a multi-parameter instrument capable of measuring pH, oxidation/reduction potential (ORP), dissolved oxygen (DO), specific conductance, temperature, and coupled with a flow-through-cell is required when measuring all indicator field parameters, except turbidity. Turbidity is collected using a separate instrument. Record equipment/instrument identification (manufacturer, and model number).

Transparent, small volume flow-through-cells (e.g., 250 mLs or less) are preferred. This allows observation of air bubbles and sediment buildup in the cell, which can interfere with the operation of the monitoring instrument probes, to be easily detected. A small volume cell facilitates rapid turnover of water in the cell between measurements of the indicator field parameters.

It is recommended to use a flow-through-cell and monitoring probes from the same manufacturer and model to avoid incompatibility between the probes and flow-through-cell.

Turbidity samples are collected before the flow-through-cell. A “T” connector coupled with a valve is connected between the pump’s tubing and flow-through-cell. When a turbidity measurement is required, the valve is opened to allow the groundwater to flow into a container. The valve is closed and the container sample is then placed in the turbidimeter.

Standards are necessary to perform field calibration of instruments. A minimum of two standards are needed to bracket the instrument measurement range for all parameters except ORP which use a Zobell solution as a standard. For dissolved oxygen, a wet sponge used for the 100% saturation and a zero dissolved oxygen solution are used for the calibration.

Barometer (used in the calibration of the Dissolved Oxygen probe) and the conversion formula to convert the barometric pressure into the units of measure used by the Dissolved Oxygen meter are needed.

J. Decontamination supplies

Includes (for example) non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.

K. Record keeping supplies

Logbook(s), well purging forms, chain-of-custody forms, field instrument calibration forms, etc.

L. Sample bottles

M. Sample preservation supplies (as required by the analytical methods)

N. Sample tags or labels

O. PID or FID instrument

If appropriate, to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

P. Miscellaneous Equipment

Equipment to keep the sampling apparatus shaded in the summer (e.g., umbrella) and from freezing in the winter. If the pump's tubing is allowed to heat up in the warm weather, the cold groundwater may degas as it is warmed in the tubing.

8.0 EQUIPMENT/INSTRUMENT CALIBRATION

Prior to the sampling event, perform maintenance checks on the equipment and instruments according to the manufacturer's manual and/or applicable SOP. This will ensure that the equipment/instruments are working properly before they are used in the field.

Prior to sampling, the monitoring instruments must be calibrated and the calibration documented. The instruments are calibrated using U.S Environmental Protection Agency Region 1 *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017, or latest version or from one of the methods listed in 40CFR136, 40CFR141 and SW-846.

The instruments shall be calibrated at the beginning of each day. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range. At the end of each day, a calibration check is performed to verify that instruments remained in calibration throughout the day. This check is performed while the instrument is in measurement mode, not calibration mode. If the field instruments are being used to monitor the natural attenuation parameters, then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration. Note: during the day if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only), this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation occurs the data from this instrument will need to be qualified or rejected.

9.0 PRELIMINARY SITE ACTIVITIES (as applicable)

Check the well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted).

If needed, lay out a sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, etc.).

Remove well cap and if appropriate measure VOCs at the rim of the well with a PID or FID instrument and record reading in field logbook or on the well purge form.

If the well casing does not have an established reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook (consider a photographic record as well). All water level measurements must be recorded relative to this reference point (and the altitude of this point should be determined using techniques that are appropriate to site's DQOs.

If water-table or potentiometric surface map(s) are to be constructed for the sampling event, perform synoptic water level measurement round (in the shortest possible time) before any purging and sampling activities begin. If possible, measure water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) the day before sampling begins, in order to allow for re-settlement of any particulates in the water column. This is especially important for those wells that have not been recently sampled because sediment buildup in the well may require the well to be redeveloped. If measurement of total well depth is not made the day before, it should be measured after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe may not be necessary unless analytical data or field analysis signal a worsening situation. This SOP cannot be used in the presence of LNAPLs or DNAPLs. If NAPLs are present, the project team must decide upon an alternate sampling method. All project modifications must be approved and documented prior to implementation.

If available check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). If changes are made in the intake depth or extraction rate(s) used during previous sampling event(s), for either portable or dedicated extraction devices, record new values, and explain reasons for the changes in the field logbook.

10.0 PURGING AND SAMPLING PROCEDURE

Purging and sampling wells in order of increasing chemical concentrations (known or anticipated) are preferred.

The use of dedicated pumps is recommended to minimize artificial mobilization and entrainment of particulates each time the well is sampled. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

A. Initial Water Level

Measure the water level in the well before installing the pump if a non-dedicated pump is being used. The initial water level is recorded on the purge form or in the field logbook.

B. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the appropriate depth (may not be the mid-point of the screen/open interval). The Sampling and Analysis Plan/Quality Assurance Project Plan should specify the sampling depth (used previously), or provide criteria for selection of intake depth for each new well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well.

Pump tubing lengths, above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

C. Measure Water Level

Before starting pump, measure water level. Install recording pressure transducer, if used to track drawdowns, to initialize starting condition.

D. Purge Well

From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. This information is recorded on the purge form or in the field logbook.

Start the pump at low speed and slowly increase the speed until discharge occurs. Check water level. Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging.

Monitor and record the water level and pumping rate every five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. If the initial water level is above the top of the screen do not allow the water level to fall into the well screen. The final purge volume must be greater than the stabilized drawdown volume plus the pump’s tubing volume. If the drawdown has exceeded 0.3 feet and stabilizes, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump’s tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

Avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples.

Note: the flow rate used to achieve a stable pumping level should remain constant while monitoring the indicator parameters for stabilization and while collecting the samples.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (e.g., bladder, peristaltic), and/or the use of dedicated equipment. For new monitoring wells, or wells where the following situation has not occurred before, if the recovery rate to the well is less than 50 mL/min., or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. The project manager or field team leader will need to make the decision when samples should be collected, how the sample is to be collected, and the reasons recorded on the purge form or in the field logbook. A water level measurement needs to be performed and recorded before samples are collected. If the project manager decides to collect the samples using the pump, it is best during this recovery period that the pump intake tubing not be removed, since this will aggravate any turbidity problems. Samples in this specific situation may be collected without stabilization of indicator field parameters. Note that field conditions and efforts to overcome problematic situations must be recorded in order to support field decisions to deviate from normal procedures described in this SOP. If this type of problematic situation persists in a well, then water sample collection should be changed to a passive or no-purge method, if consistent with the site's DQOs, or have a new well installed.

E. Monitor Indicator Field Parameters

After the water level has stabilized, connect the "T" connector with a valve and the flow-through-cell to monitor the indicator field parameters. If excessive turbidity is anticipated or encountered with the pump startup, the well may be purged for a while without connecting up the flow-through-cell, in order to minimize particulate buildup in the cell (This is a judgment call made by the sampler). Water level drawdown measurements should be made as usual. If possible, the pump may be installed the day before purging to allow particulates that were disturbed during pump insertion to settle.

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) at a frequency of five minute intervals or greater. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 mLs/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell it would be every ten minutes). If the cell volume cannot be replaced in the five minute interval, then the time between measurements must be increased accordingly. Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments followed by stabilization of indicator parameters. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Samples for turbidity measurements are obtained before water enters the flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities. Record start and stop times and give a brief description of cleaning activities.

The flow-through-cell must be designed in a way that prevents gas bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see Appendix B Low-Flow Setup Diagram). Throughout the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must remain submerged in water at all times.

F. Collect Water Samples

When samples are collected for laboratory analyses, the pump's tubing is disconnected from the "T" connector with a valve and the flow-through-cell. The samples are collected directly from the pump's tubing. Samples must not be collected from the flow-through-cell or from the "T" connector with a valve.

VOC samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the pump's flow rate is too high to collect the VOC/dissolved gases samples, collect the other samples first. Lower the pump's flow rate to a reasonable rate and collect the VOC/dissolved gases samples and record the new flow rate.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use the following procedure to collect samples: collect non-VOC/dissolved gases samples first, then increase flow rate slightly until the water completely fills the tubing, collect the VOC/dissolved gases samples, and record new drawdown depth and flow rate.

For bladder pumps that will be used to collect VOC or dissolved gas samples, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL VOC vial.

Use pre-preserved sample containers or add preservative, as required by analytical methods, to the samples immediately after they are collected. Check the analytical methods (e.g. EPA SW-846, 40 CFR 136, water supply, etc.) for additional information on preservation.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter (transparent housing preferred) is required, and the filter size (0.45 µm is commonly used) should be based on the sampling objective. Pre-rinse the filter with groundwater prior to sample collection. Make sure the filter is free of air bubbles before samples are collected. Preserve the filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health or ecological risk calculations.

Label each sample as collected. Samples requiring cooling will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

G. Post Sampling Activities

If a recording pressure transducer is used to track drawdown, re-measure water level with tape.

After collection of samples, the pump tubing may be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth annually is usually sufficient after the initial low stress sampling event. However, a greater frequency may be needed if the well has a “silting” problem or if confirmation of well identity is needed.

Secure the well.

11.0 DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well, and then following sampling of each subsequent well. Pumps should not be removed between purging and sampling operations. The pump, tubing, support cable and electrical wires which were in contact with the well should be decontaminated by one of the procedures listed below.

The use of dedicated pumps and tubing will reduce the amount of time spent on decontamination of the equipment. If dedicated pumps and tubing are used, only the initial sampling event will require decontamination of the pump and tubing.

Note if the previous equipment blank data showed that contaminant(s) were present after using the below procedure or the one described in the SAP/QAPP, a more vigorous procedure may be needed.

Procedure 1

Decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump and tubing. The pump may be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Optional - flush with isopropyl alcohol (pesticide grade; must be free of ketones {e.g., acetone}) or with methanol. This step may be required if the well is highly contaminated or if the equipment blank data from the previous sampling event show that the level of contaminants is significant.

Flush with distilled/deionized water. This step must remove all traces of alcohol (if used) from the equipment. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

12.0 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. Quality control samples include field duplicates, equipment blanks, matrix spike/matrix spike duplicates, trip blanks (VOCs), and temperature blanks.

13.0 FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities (see Appendix C, example table), and record the following for each well:

Site name, municipality, state.

Well identifier, latitude-longitude or state grid coordinates.

Measuring point description (e.g., north side of PVC pipe).

Well depth, and measurement technique.

Well screen length.

Pump depth.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.

Type of tubing used and its length.

Type of pump used.

Clock time of start and end of purging and sampling activity.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analyses.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions, including approximate ambient air temperature.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling/monitoring equipment used, including trade names, model number, instrument identification number, diameters, material composition, etc.

14.0 DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, field indicator parameters measured during purging, field instrument calibration information, and whatever other field logbook information is needed to allow for a full evaluation of data usability.

Note: the use of trade, product, or firm names in this sampling procedure is for descriptive purposes only and does not constitute endorsement by the U.S. EPA.

15.0 REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, *DNAPL Site Evaluation*; C.K. Smoley (CRC Press), Boca Raton, Florida.

Robert W. Puls and Michael J. Barcelona, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996 (EPA/540/S-95/504).

U.S. Environmental Protection Agency, 1992, *RCRA Ground-Water Monitoring: Draft Technical Guidance*; Washington, DC (EPA/530-R-93-001).

U.S. Environmental Protection Agency, 1987, *A Compendium of Superfund Field Operations Methods*; Washington, DC (EPA/540/P-87/001).

U.S Environmental Protection Agency, Region 1, *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017 or latest version.

U.S Environmental Protection Agency, EPA SW-846.

U.S Environmental Protection Agency, 40 CFR 136.

U.S Environmental Protection Agency, 40 CFR 141.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, Influence of Dissolved Oxygen Convection on Well Sampling, *Ground Water Monitoring & Remediation* 27, no. 3: 49-58.

APPENDIX A

PERISTALTIC PUMPS

Before selecting a peristaltic pump to collect groundwater samples for VOCs and/or dissolved gases, (e.g., methane, carbon dioxide, etc.) consideration should be given to the following:

- The decision of whether or not to use a peristaltic pump is dependent on the intended use of the data.
- If the additional sampling error that may be introduced by this device is NOT of concern for the VOC/dissolved gases data's intended use, then this device may be acceptable.
- If minor differences in the groundwater concentrations could affect the decision, such as to continue or terminate groundwater cleanup or whether the cleanup goals have been reached, then this device should NOT be used for VOC/dissolved gases sampling. In these cases, centrifugal or bladder pumps are a better choice for more accurate results.

EPA and USGS have documented their concerns with the use of the peristaltic pumps to collect water sample in the below documents.

- "Suction Pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.
- "The agency does not recommend the use of peristaltic pumps to sample ground water particularly for volatile organic analytes" *RCRA Ground-Water Monitoring Draft Technical Guidance*, EPA Office of Solid Waste, November 1992.
- "The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and volatiles loss", *Low-flow (Minimal drawdown) Ground-Water Sampling Procedures*, by Robert Puls & Michael Barcelona, April 1996, EPA/540/S-95/504.
- "Suction-lift pumps, such as peristaltic pumps, can operate at a very low pumping rate; however, using negative pressure to lift the sample can result in the loss of volatile analytes", USGS Book 9 Techniques of Water-Resources Investigation, Chapter A4. (Version 2.0, 9/2006).

APPENDIX B

SUMMARY OF SAMPLING INSTRUCTIONS

These instructions are for using an adjustable rate, submersible pump or a peristaltic pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. The water level in the monitoring well is above the top of the well screen or open interval, the ambient temperature is above 32°F, and the equipment is not dedicated. Field instruments are already calibrated. The equipment is setup according to the diagram at the end of these instructions.

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of screen/open interval).

2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, lay out a sheet of polyethylene around the well (if necessary), and setup the equipment. If necessary a canopy or an equivalent item can be setup to shade the pump's tubing and flow-through-cell from the sun light to prevent the sun light from heating the groundwater.

3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.

4. Install the pump's intake to the appropriate depth (e.g., midpoint) of the well screen or open interval. Do not turn-on the pump at this time.

5. Measure water level and record this information.

6. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen.

If the groundwater is highly turbid or discolored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or discolored water is usually from the well-being disturbed during the pump installation. If the water does not clear, then you need to make a choice whether to continue purging the well (hoping that it will clear after a reasonable time) or continue to the next step. Note, it is sometimes helpful to install the pump the day before the sampling event so that the disturbed materials in the well can settle out.

If the water level drops to the top of the well screen during the purging of the well, stop purging the well, and do the following:

> Wait for the well to recharge to a sufficient volume so samples can be collected. This may take a while (pump may be removed from well, if turbidity is not a problem). The project manager will need to make the decision when samples should be collected and the reasons recorded in the site's log book. A water level measurement needs to be performed and recorded before samples are collected. When samples are being collected, the water level must not drop below the top of the screen or open interval. Collect the samples from the pump's tubing. Always collect the VOCs and dissolved gases samples first. Normally, the samples requiring a small volume are collected before the large volume samples are collected just in case there is not sufficient water in the well to fill all the sample containers. All samples must be collected, preserved, and stored according to the analytical method. Remove the pump from the well and decontaminate the sampling equipment.

If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 7. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

7. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes and allow the gas bubbles to exit the cell easily (see Low-Flow Setup Diagram). Note:

make sure there are no gas bubbles caught in the probes' protective guard; you may need to shake the cell to remove these bubbles.

8. Turn-on the monitoring probes and turbidity meter.

9. Record the temperature, pH, dissolved oxygen, specific conductance, and oxidation/reduction potential measurements. Open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, do the measurement, and record this measurement. Calculate the pump's flow rate from the water exiting the flow-through-cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them.

10. Repeat Step 9 every 5 minutes or as appropriate until monitoring parameters stabilized. Note: at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within the following limits:

Turbidity (10% for values greater than 5 NTUs; if three Turbidity values are less than 5 NTUs, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

If these stabilization requirements do not stabilize in a reasonable time, the probes may have been coated from the materials in the groundwater, from a buildup of sediment in the flow-through-cell, or a gas bubble is lodged in the probe. The cell and the probes will need to be cleaned. Turn-off the probes (not the pump), disconnect the cell from the "T" connector and continue to purge the well. Disassemble the cell, remove the sediment, and clean the probes according to the manufacturer's instructions. Reassemble the cell and connect the cell to the "T" connector. Remove all gas bubbles from the cell, turn-on the probes, and continue the measurements. Record the time the cell was cleaned.

11. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. If you are using a centrifugal or peristaltic pump check the pump's tubing to determine if the tubing is completely filled with water (no air space).

All samples must be collected and preserved according to the analytical method. VOCs and dissolved gases samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

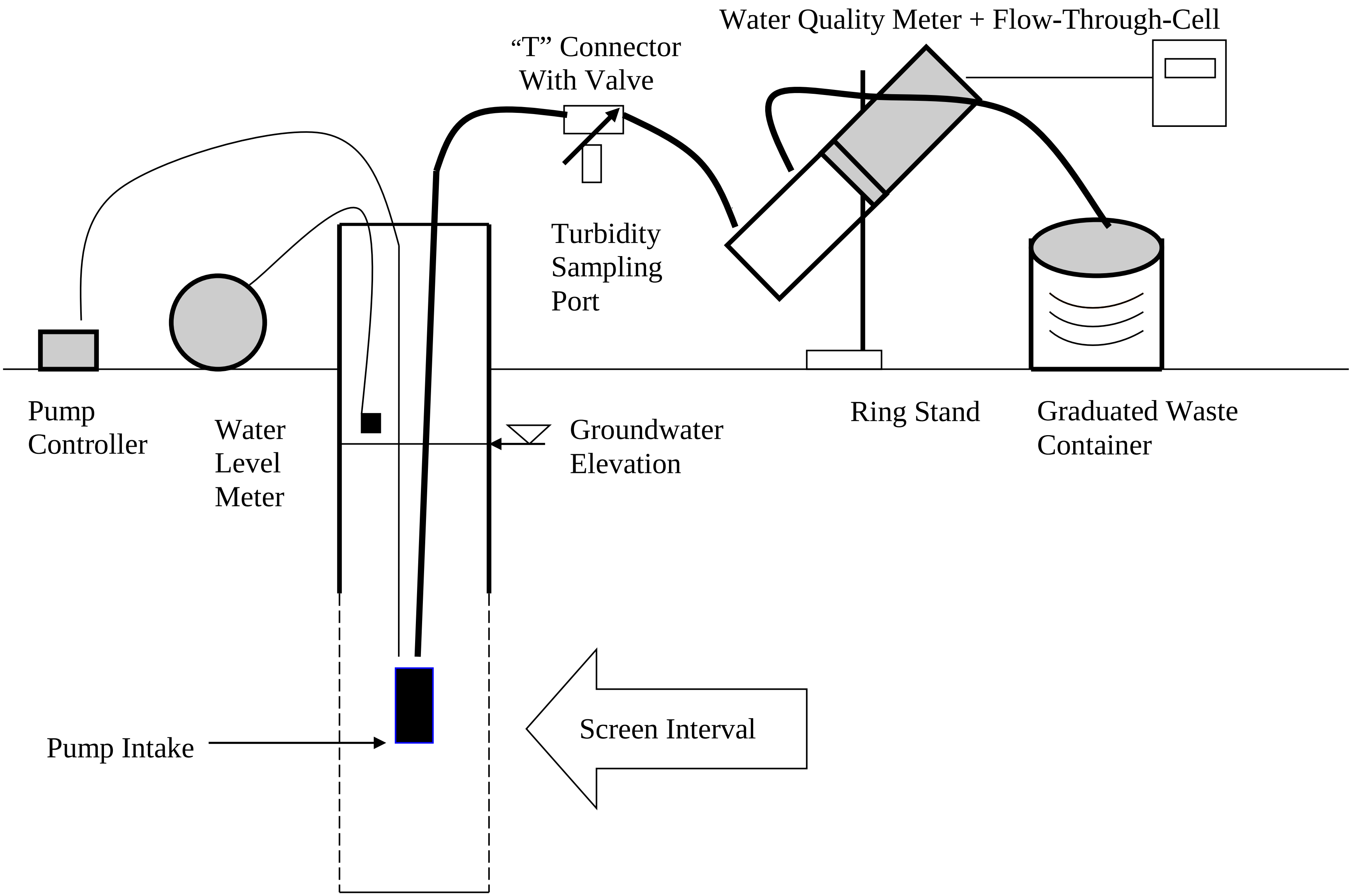
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

> All samples must be collected and preserved according to the analytical method. The VOCs and the dissolved gases (e.g., methane, ethane, ethene, and carbon dioxide) samples are collected last. When it becomes time to collect these samples increase the pump's flow rate until the tubing is completely filled. Collect the samples and record the new flow rate.

12. Store the samples according to the analytical method.

13. Record the total purged volume (graduated waste bucket). Remove the pump from the well and decontaminate the sampling equipment.

Low-Flow Setup Diagram



APPENDIX C

EXAMPLE (Minimum Requirements)

WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)________________________________
Well Number_________________ Date________________________
Field Personnel____
Sampling Organization______________________________________
Identify MP____

Depth to ________/_________ of screen
(below MP) top bottom
Pump Intake at (ft. below MP)_________
Purging Device; (pump type)__________
Total Volume Purged _______________

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. "C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Tur-bidity NTU	Comments

Stabilization Criteria 3% 3% ±0.1 ±10 mv 10% 10%

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25°C.
3. Oxidation reduction potential (ORP)

ATTACHMENT B

GUIDELINES AND PROTOCOLS FOR FPOA SAMPLING

February 2019

Sampling for 1,4-Dioxane and Per- and Polyfluoroalkyl Substances (PFAS) Under DEC's Part 375 Remedial Programs

Objective

The Department of Environmental Conservation (DEC) is requiring sampling of all environmental media and subsequent analysis for the emerging contaminants 1,4-Dioxane and PFAS as part of all remedial programs implemented under 6 NYCRR Part 375, as further described in the guidance below.

Sample Planning

The number of samples required for emerging contaminant analyses is to be the same number of samples where "full TAL/TCL sampling" would typically be required in an investigation or remedial action compliance program.

Upon a new site being brought into any program (e.g., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of potentially affected media, including soil, groundwater, surface water, and sediment as an addition to the standard "full TAL/TCL sampling." Biota sampling may be necessary based upon the potential for biota to be affected as determined pursuant to a Fish and Wildlife Impact analysis. Soil vapor sampling for PFAS and 1,4-dioxane is not required.

Upon an emerging contaminant being identified as a contaminant of concern (COC) for a site, those compounds must be assessed as part of the remedy selection process in accordance with Part 375 and DER-10 and included as part of the monitoring program upon entering the site management phase.

Soil imported to a site for use in a soil cap, soil cover, or as backfill must be sampled for 1,4-dioxane and PFAS contamination in general conformance with DER-10, section 5.4(e). Assessment of the soil data will be made on a site-specific basis to determine appropriateness for use.

The work plan should explicitly describe analysis and reporting requirements, including laboratory analytical procedures for modified methods discussed below.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by an independent 3rd party data validator. QA/QC samples should be collected as required in DER-10, Section 2.3(c). The electronic data submission should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

PFAS analysis and reporting: DEC has developed a *PFAS Analyte List* (below) for remedial programs. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any compounds, the DEC project manager, in consultation with the DEC remedial program chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site.

Currently, ELAP does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (e.g., soil, sediments, and groundwater) are required by DER to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537 or ISO 25101.

Modified EPA Method 537 is the preferred method to use for environmental samples due to its ability to achieve very low detection limits. Reporting limits for PFAS in groundwater and soil are to be 2 ng/L (ppt) and 1 ug/kg (ppb), respectively. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve these reporting limits for the entire list of 21 PFAS, site-specific decisions will need to be made by the DEC project manager in consultation with the DEC remedial program chemist. Note: Reporting limits for PFOA and PFOS in groundwater should not exceed 2 ng/L.

Additional laboratory methods for analysis of PFAS may be warranted at a site. These methods include Synthetic Precipitation Leaching Procedure (SPLP) by EPA Method 1312 and Total Oxidizable Precursor Assay (TOP Assay).

SPLP is a technique for determining the potential for chemicals in soil to leach to groundwater and may be helpful in determining the need for addressing PFAS-containing soils or other solid material as part of the remedy. SPLP sampling need not be considered if there are no elevated PFAS levels in groundwater. If elevated levels of PFAS are detected in water, and PFAS are also seen in soil, then an SPLP test should be considered to better understand the relationship between the PFAS in the two media.

The TOP Assay can assist in determining the potential PFAS risk at a site. For example, some polyfluoroalkyl substances may transform to form perfluoroalkyl substances, resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from the site. To conceptualize the amount and type of oxidizable perfluoroalkyl substances which could be liberated in the environment, a “TOP Assay” analysis can be performed, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized.

PFAS-containing materials can be made up of per- and polyfluoroalkyl substances that are not analyzable by routine analytical methodology (LC-MS/MS). The TOP assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by current analytical methodology. Please note that analysis of highly contaminated samples, such as those from an AFFF site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. Please consult with a DEC remedial program chemist for assistance interpreting the results.

1,4-Dioxane analysis and reporting: The reporting limit for 1,4-dioxane in groundwater should be no higher than 0.35 µg/L (ppb) and no higher than 0.1 mg/kg (ppm) in soil. Although ELAP offers certification for both EPA Method 8260 SIM and EPA Method 8270 SIM in waters, DER is advising the use of Method 8270 SIM because it provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane in soil, which already has an established SCO.

Refinement of sample analyses

As with other contaminants that are analyzed for at a site, the emerging contaminant analyte list may be refined for future sampling events based on investigative findings. Initially, however, sampling using this PFAS Analyte List and 1,4-dioxane is needed to understand the nature of contamination.

PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	PFOS	1763-23-1
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	PFHpA	375-85-9
	Perfluorooctanoic acid	PFOA	335-67-1
	Perfluorononanoic acid	PFNA	375-95-1
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Groundwater Sampling for Emerging Contaminants

February 2018

Issue: NYSDEC has committed to analyzing representative groundwater samples at remediation sites for emerging contaminants (1,4-dioxane and PFAS) as described in the below guidance.

Implementation

NYSDEC project managers will be contacting site owners to schedule sampling for these chemicals. Only groundwater sampling is required. The number of samples required will be similar to the number of samples where “full TAL/TCL sampling” would typically be required in a remedial investigation. If sampling is not feasible (e.g., the site no longer has any monitoring wells in place), sampling may be waived on a site-specific basis after first considering potential sources of these chemicals and whether there are water supplies nearby.

Upon a new site being brought into any program (i.e., SSF, BCP), PFAS and 1,4-dioxane will be incorporated into the investigation of groundwater as part of the standard “full TAL/TCL” sampling. Until an SCO is established for PFAS, soil samples do not need to be analyzed for PFAS unless groundwater contamination is detected. Separate guidance will be developed to address sites where emerging contaminants are found in the groundwater. The analysis currently performed for SVOCs in soil is adequate for evaluation of 1,4-dioxane, which already has an established SCO.

Analysis and Reporting

Labs should provide a full category B deliverable, and a DUSR should be prepared by a data validator.

The work plan should explicitly describe analysis and reporting requirements.

PFAS sample analysis: Samples should be analyzed by an environmental laboratory certified by ELAP to use EPA method 537 or ISO 25101. ELAP does not currently offer certification for PFAS analysis of non-drinking water samples (including groundwater, soil and sediment), so there is no requirement to use an ELAP certified method. The preferred method is the modified EPA Method 537. Labs have been able to achieve reporting limits for PFOA and PFOS of 2 ng/l (part per trillion). If labs are not able to achieve similar reporting limits, the NYSDEC project manager will make case-by-case decisions as to whether the analysis can meet the needs for the specific site.

PFAS sample reporting: DER has developed a PFAS target analyte list (below) with the intent of achieving reporting consistency between labs for commonly reportable analytes. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. This list may be updated in the future as new information is learned and as labs develop new capabilities. If lab and/or matrix specific issues are encountered for any particular compounds, the NYSDEC project manager will make case-by-case decisions as to whether particular analytes may be temporarily or permanently discontinued from analysis for each site. Any technical lab issues should be brought to the attention of a NYSDEC chemist.

Some sampling using this full PFAS target analyte list is needed to understand the nature of contamination. It may also be critical to differentiate PFAS compounds associated with a site from other sources of these chemicals. Like routine refinements to parameter lists based on investigative findings, the full PFAS target analyte list may not be needed for all sampling intended to define the extent of

Collection of Groundwater Samples for Perfluorooctanoic Acid (PFOA) and Perfluorinated Compounds (PFCs) from Monitoring Wells Sample Protocol

Samples collected using this protocol are intended to be analyzed for perfluorooctanoic acid (PFOA) and other perfluorinated compounds by Modified (Low Level) Test Method 537.

The procedure used must be consistent with the NYSDEC March 1991 Sampling Guidelines and Protocols http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf with the following materials limitations.

At this time acceptable materials for sampling include: stainless steel, high density polyethylene (HDPE), PVC, silicone, acetate and polypropylene. Equipment blanks should be generated at least daily. Additional materials may be acceptable if pre-approved by NYSDEC. Requests to use alternate equipment should include clean equipment blanks. **NOTE: Grunfos pumps and bladder pumps are known to contain PFC materials (e.g. Teflon™ washers for Grunfos pumps and LDPE bladders for bladder pumps).** All sampling equipment components and sample containers should not come in contact with aluminum foil, low density polyethylene (LDPE), glass or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer. Standard two step decontamination using detergent and clean water rinse will be performed for equipment that does come in contact with PFC materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFC materials must be avoided. Many food and drink packaging materials and “plumbers thread seal tape” contain PFCs.

All clothing worn by sampling personnel must have been laundered multiple times. The sampler must wear nitrile gloves while filling and sealing the sample bottles.

Pre-cleaned sample bottles with closures, coolers, ice, sample labels and a chain of custody form will be provided by the laboratory.

1. Fill two pre-cleaned 500 mL HDPE or polypropylene bottle with the sample.
2. Cap the bottles with an acceptable cap and liner closure system.
3. Label the sample bottles.
4. Fill out the chain of custody.
5. Place in a cooler maintained at 4 ± 2º Celsius.

Collect one equipment blank for every sample batch, not to exceed 20 samples.

Collect one field duplicate for every sample batch, not to exceed 20 samples.

Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, not to exceed 20 samples.

Request appropriate data deliverable (Category A or B) and an electronic data deliverable.

contamination. Project managers may approve a shorter analyte list (e.g., just the UCMR3 list) for some reporting on a case by case basis.

1,4-Dioxane Analysis and Reporting: The method detection limit (MDL) for 1,4-dioxane should be no higher than 0.28 µg/l (ppb). ELAP offers certification for both EPA Methods 8260 and 8270. In order to get the appropriate detection limits, the lab would need to run either of these methods in “selective ion monitoring” (SIM) mode. DER is advising PMS to use 8270, since this method provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents (we acknowledge that 8260 has been shown to have a higher recovery in some studies).

Full PFAS Target Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	**Perfluorobutanesulfonic acid**	**PFBS**	**375-73-5**
	Perfluorohexanesulfonic acid	**PFHxS**	**355-46-4**
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanessulfonic acid	**PFOS**	**1763-23-1**
	Perfluorodecanesulfonic acid	PFDS	335-77-3
Perfluoroalkyl carboxylates	Perfluorobutanoic acid	PFBA	375-22-4
	Perfluoropentanoic acid	PFPeA	2706-90-3
	Perfluorohexanoic acid	PFHxA	307-24-4
	Perfluoroheptanoic acid	**PFHpA**	**375-85-9**
	Perfluorooctanoic acid	**PFOA**	**335-67-1**
	Perfluorononanoic acid	**PFNA**	**375-95-1**
	Perfluorodecanoic acid	PFDA	335-76-2
	Perfluoroundecanoic acid	PFUA/PFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriA/PFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTA/PFTeDA	376-06-7
Fluorinated Telomer Sulfonates	6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
	8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
Perfluorooctane-sulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

Bold entries depict the 6 original UCMR3 chemicals

ATTACHMENT C

GROUNDWATER SAMPLING/PURGE LOG

HydroTech Environmental
ENGINEERING AND GEOLOGY, DPC

Monitoring Well Sampling Log Sheet

Job No.: ______________ **Well No.:** ______________ **Date:** __/__/__

Well Depth: ____________ **Screen Length:** _______________ **Well Diameter:** ___________ **Casing Type:** ___________

Sampling Device: ________________ **Tubing Type:** _______ **Initial DTP:** ______________ **Initial DTW:** ____________

Well Volume: ____________________ **Total Volume Purged:** _____________

Sampling Personnel:____

Low Flow Sampling required ? Yes : _________ No: ____________

Order of stabilization			a	b	c	e	f	d	
Deviation			±1		± 3%	± 10%	± 10%	± 10 mv	
Time	**DTP (ft)**	**DTW (ft)**	**pH**	**Temp (ºF)**	**Cond. (S/Cm)**	**Dis.O2 (mg/L)**	**Turb.(NTU)**	**ORP (mV)**	**Notes**

ATTACHMENT D
RESUME OF KEY PERSONNEL

TAREK Z. KHOURI, P.E. *Principal Environmental Engineer*

Education

M.S. Environmental Engineering, University of Central Florida

B.S. Chemistry, University of Central Florida

Professional Registration

Professional Engineer (P.E.)
Connecticut # 0031583
D.C. # 908711
Maryland # 49155
Massachusetts # 52601
New Jersey # 24GE04697200
New York # 086611
Pennsylvania # PE084919
Rhode Island # 12059
Texas # 125442
Virginia # 0402056415

Certifications

OSHA: 40 Hour HAZWOPER; 8 Hour Supervisor Management; 10 Hour Construction Safety

USACE Construction Quality Management

Affiliations

Transportation & Infrastructure Committee, NY Building Congress (NYBC), NY, USA

Environmental and Energy Committee, American Society of Engineering Companies (ACEC) NY, USA

Chairman (2013), Solid Waste Committee, Qatar Green Building Council (QGBC) Qatar

Legislative Committee (2008-2010), National Brownfield Association (NBA), NY, USA

Environmental Council (2008-2010), The Business Council of NY State (BCNY), NY, USA

Summary of Experience

Mr. Khouri has more than 20 years of experience in the real estate development, construction and engineering industries.

He has been a trusted partner, providing environmental consulting services to public and private sector clients including developers, real estate owners, investors, facility managers and city, state and federal agencies and municipalities.

Mr. Khouri has participated and managed the remediation and reuse of contaminated properties for over 20 years. He has performed, directed, and overseen environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, fuel farms, refineries, former manufactured gas, landfills, and a variety of residential, commercial and industrial settings.

Mr. Khouri integrates environmental risk management with land use planning and sustainable development to meet the needs and objectives of diverse clients and stakeholders for residential, commercial, and industrial real estate, in urban and rural environment. Mr. Khouri utilizes his technical expertise as well as his leadership and management skills to direct and oversee teams of professionals for the successful completion of these complex projects.

Relevant Experience

- **Principal Environmental Engineer** – Hydro Tech Environmental Engineering and Geology, DPC (2017-Present)
- **Senior Vice President** – HAKS (2015-2017)
- **Vice President** – Langan Engineering and Environmental Services, USA. (2013-2015)
- **Managing Director** – Averda Environmental Services, Qatar. (2011-2013)
- **Managing Director** – Clean Planet International, USA, Africa and Middle East. (2010-2011)
- **Associate** – Langan Engineering and Environmental Services, USA and Middle East. (2004-2010)
- **Senior Project Manager** – URS Corporation, USA and Middle East. (1998-2004)
- **Senior Scientist** – Solidere, Lebanon. (1996-1998)
- **Environmental Engineer** – University of Central Florida, USA. (1994-1996)

- **Environmental Impact Assessments, Phase I ESAs, and Phase II ESIs - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, and Insurance Firms -** Conducted 100s of environmental assessments for various entities specializing in urban renewal: Mixed use, residential, commercial, retail, warehouses, manufacturing facilities, gas stations and vacant lands. I also designed and executed subsurface investigations for soil, groundwater, and soil gas.

- **Remedial Investigation, Remedial Design and Associated Remediation Projects - Clients: Developers, Property Managers, Environmental Attorneys, Architects, Banks, Insurance Firms -** Managed myriads of environmental investigations and remedial actions at petroleum and chlorinated solvent spill sites, former manufactured gas and a variety of other commercial and industrial settings. Constituents of concern have included LNAPLs and DNAPLs, petroleum hydrocarbons, chlorinated solvents, soil vapor, coal tar, creosote, PCBs, and metals. Managed and participated in historical research, sample collection and data evaluation, synthesis of information to determine site-specific cleanup levels, remedial technology evaluation, design of treatment systems, site cleanup, installation and operation of treatment systems, optimizing systems, and performance monitoring.

- **LIRR/MTA East Side Access Project, New York, NY - Client: MTA -** The project involves the construction of new metro tunnels system in densely developed areas of midtown Manhattan, new tunnels system construction beneath active Amtrak, Metro North and NYCTA facilities, construction of new terminals, ventilation facilities, off street entrances, and yards development. In addition to establishing the guidelines of the project specific environmental management system, I provided direct and extensive public and community relations outreach, educational and awareness programs, as well technical support for the design engineering and construction teams, inspectors, and environmental sub consultants, so that construction of the project proceeds in compliance with environmental commitments, be conducted under budget and on time, while maintaining the utmost quality. Another key component of the project success was the direct and constant coordination between the environmental department and the multiple agencies and operators/owners of the project, such as USEPA, NYSDEC, NYSDOH, NYCDOT, NYCDEP, NYCDOB, MTA, LIRR, NYCTA, Amtrak, and Metro North. Construction Cost: $8.4 Billion

- **Hudson Yards, Proposed New York Jets Stadium, New York, NY – Client: NY Jets -** Served as the environmental project manager for the due diligence, investigation, and preliminary design phases of the proposed Jets Stadium. The work included subsurface investigation for soil, groundwater, and soil gas, and required close interaction with multiple entities including the MTA, LIRR, NYCTA, NYCDOS, NYSDEC, and Amtrak. Construction Cost: $1.4 Billion

- **Columbia University Manhattanville Expansion Project, New York, NY – Client: Columbia University -** Columbia University new campus will be built within a 17-acre area and will be comprised of academic and research facilities, housing, as well as commercial retail stores and open space areas. As the senior environmental project manager, I oversaw all environmental engineering related activities, including site assessment prior to the development, pre-construction support for demolition, recycling, soil and groundwater management, air quality controls, and LEED certification support. Construction Cost: $2+ Billion

- **Potable Water System Testing for Lead, New York, NY – Client: NYCSCA -** Directly managed the emergency work for the sampling, testing, evaluation and reporting of lead in the potable water of approximately 300 public schools in New York City. HAKS was one of the main consultants working for NYCSCA to implement a potable water system testing protocol which included coordination with school facilities, field work encompassing flushing and sampling, laboratory testing, analyzing, and reporting sample results. The project was conducted on a tight 24/7 timetable. The project was completed successfully under the direct supervision and daily coordination with the NYCSCA, with limited to no disturbance to schools' schedule and extracurricular activities, on time and on budget.

- **City University of New York, Tank Rehabilitation, Remediation and Closure Program, New York, NY – Client: DASNY -** Served as the project manager for the technical assessment, remediation design, and oversight of the Underground Storage Tank (UST) facilities at seven City

University campuses. Tanks sizes ranged from 550 Gal to 50,000 Gal. The work included design drawings and construction documents for the tanks and dispensing systems for vapor recovery, fire suppression, electronic monitoring/sensing, pumping/delivery, storage tank details, site restoration, subsurface investigation, and spill remediation. Construction Cost: $5 Million

- **Active Fuel Oil Terminal, Brooklyn, NY – Client: Bayside Fuel Oil Depot Corporation -** Managed the remedial investigation in connection with petroleum releases at an active fuel oil terminal located on Gravesend Bay. Developed and executed a strategy to manage client's liability relating to light non-aqueous phase liquid (LNAPL). Negotiated an alternative remedial action which benefitted the adjacent property and NYSDEC while eliminating client from liabilities at the adjacent property. Investigated and evaluated storm water infrastructure, and included an updated storm water management plan, as part of a sustainable groundwater remedy. Fees: $1.1 Million

- **54 Rutledge St, Insitu Bio-Remediation, Brooklyn, NY – Client: Fortis Property Group -** Managed the implementation of a remedial action for major petroleum and gasoline spills. The remedial action consisted of a multi-phased approach to site cleanup, which included excavation and removal of contaminated soil and groundwater, removal of underground storage tanks, injection of chemical oxidation compounds into the groundwater table, installation of permanent remedial injection and monitoring points, installation of a soil vapor mitigation system, and delineation of off-site contamination. Fees: $1.0 Million

- **Circuitron Corporation Superfund Site, Ground Water Treatment System, East Farmingdale, NY – Client: USACE -** Served as the Project Engineer and the Health and Safety Officer providing technical direction for on-site staff, guidance in hazardous waste/material management, and performing technical review of reports and contract deliverables. Coordinated with USEPA and USACE for the day-to-day operations and quality control matters. Fees: $1.6 Million

- **Constructability Review – Justice Sonia Sotomayor Houses, Bronx, NY – Client: NYCHA -** Constructability Review for the upgrading/rehabilitation of the Justice Sonia Sotomayor Houses in the Bronx for the New York City Housing Authority (NYCHA). The scope of work includes such repairs as Local Law 11 Brick Facade repair/waterproofing for areas of significant disrepair (including brick masonry, window sills/lintels, and brick parapet replacement with metal railing); roof replacement (asbestos abatement, 4-ply insulated roofing, roof drains); interior repairs/sheet rock/painting to apartments with water damage, new window installation at all locations; replacement of the water tanks, pumps, and repairs to the water tank structures in particular buildings; repairs to the property's main loop and improvements to entrances, lobbies and security. Construction Cost: $102 Millions

- **LCP Chemicals Inc. Superfund Site, Linden, NJ – Client: LCP Chemicals Inc. -** Served as the Project Manager and the Health and Safety Officer for the interim removal action program for mercury clean up and removal, petroleum contaminated soil excavation, storage tanks and steel structure demolition. The job also included a drum landfill investigation, done in level B PPE. Awarded the 74th Annual Governor's Occupational Safety & Health Award Citation of Merit of the State of New Jersey in 2002. Fees: $1.1 Million

- **FAA Technical Center, PCB Soil Remediation at Area 20A Superfund Site, Atlantic City, NJ – Client: USACE -** Served as a Laboratory Manager for the PCB contaminated soils removal project at FAA Technical Center. Responsibilities included the development of sampling and analysis plans, establishment of project data quality objectives, evaluation and selection of laboratories for testing programs, data quality assessment, and reports preparation. Fees: $3.2 Million

- **FAA Technical Center, Area D Jet Fuel Farm Superfund Site, Atlantic City, NJ – Client: USACE -** Served as the Quality Control Manager, supervising laboratory prequalification, fieldwork, and laboratory analysis. Evaluated and optimized the operation of the groundwater treatment system, CEM, and SVE bioremediation system, and prepared quarterly reports deliverables to the USEPA and the USACE. Also performed quality assurance audit and review for the pre-excavation sampling results performed by FAA subcontractors, using field test kits for PCB and TPH. Fees: $2.1 Million

- **US Federal Government, Anthrax Investigation, New Jersey and New York – Client: USPS -** Mr. Khouri was part of a team that was contracted by the Federal Government and the United States Postal Services (USPS) to perform Anthrax sampling and investigation throughout dozens of USPS facilities in the Northeast.

International Representative Projects

- **Global Infrastructure Project, Harare, Zimbabwe** – Provided owner representation services for conducting due diligence and feasibility studies for multibillion dollars infrastructure development projects. Projects are BOT and included a 120,000-bbd oil refinery, 300 Km oil pipeline, 20,000 unit’s housing project, resorts, telecommunication improvement, and assessing mining concessions. Construction Cost: $7.2 Billion

- **OQYANA World First, Dubai, UAE** – Provided geotechnical and waterfront/marine engineering evaluations of the island’s perimeter seawalls and ground improvement schemes, as well as seismic slope stability analysis at the edge of the islands. The proposed design effort and creative approach led to enormous budget and schedule savings for the client. Construction Cost: $1+ Billion

- **Normandy Landfill Treatment Project, Beirut, Lebanon -** Managed the remediation program of a 60 acres’ landfill reclamation project. Additionally, I corresponded with management, owners, developers, and government representatives, and my involvement with the project from the design stage throughout the full remediation led to the project ultimate success with regard to the remediation design and schedule and budget compliance. Construction Cost: $65 Million

- **Beach Restoration, Al Athaiba Beach (Muscat, Oman) and Saint Germain sur Ay Beach (La Manche, France) -** Provided environmental engineering and site civil support for erosion control and restoration of the beach. Fees: $500,000

Publications

- Reductive Dehalogenation of Tetrachloroethylene by Soil Sulfate Reducing Microbes Under Various Electron Donor Conditions (2000).

- The Effect of Organic Substrates on Enhanced Biological Phosphorus Removal in Continuous Culture and Batch Experiments (1998).

- Comparison of Enhanced Biological Phosphorus Removal Populations under Ten Different Environmental Conditions (1998).

- Observations From Steady State and Batch Experiments Concerning the Effect on Enhanced Biological Phosphorus Removal of Volatile Fatty Acids and Glucose (1997).

- Single Stage Anaerobic and Aerobic Sequencing Biotransformation and Mineralization of Tetrachloroethylene (PCE) for the Remediation of Contaminated Soils and Groundwater (1996).

YORK
ANALYTICAL LABORATORIES, INC.

Teresa V. Weikel

Quality Assurance Officer

As an analytical chemist, Ms. Weikel has had over 10 years of experience in environmental laboratories with specialized expertise in Organics Analysis including organic extractions, Gas Chromatography/Mass Spectrometry and Gas Chromatography methods. She also experienced in metals analysis by ICP, and classical chemistry methods. She has also been heavily involved with QA/QC protocols for all disciplines in the Laboratory. She is fully versed in all NELAC(TNI) and ISO-17025 protocols for Quality Systems.

In the capacities of Chemist and Senior Chemist at various environmental testing laboratories, she performed and was frequently solely responsible for a wide variety of both organic and inorganic analyses and extractions in varying environmental matrices following EPA, WA State and occasional self-designed methods.

In addition to chemist responsibilities, Ms. Weikel also was responsible for setup and use of specific programs and appropriate record keeping for various government/state certifications, organization and delegation of incoming laboratory work and as a Quality Control Specialist at a biotechnology company, she wrote raw material specifications and standard operating procedures according to FDA document traceability standards.

She has had QA specific training on Internal Audit Procedures and Understanding and Implementing ISO-17025 in laboratories. She is familiar with the requirements of the NELAC 2003 standard.

At York, she holds full responsibility for the in-house Quality Systems.

Her current responsibilities focus on quality systems monitoring and implementation, technical training, data review, SOP preparation and revision, new procedure review and approval, data package review, and ethics training.

Education: B.S. Chemistry, Pacific Lutheran University Tacoma, WA

HANIBAL TAYEH, Ph.D - Data Validation and Forensic Geochemistry Expert
CURRICULUM VITAE – 2021

271 WEDGEWOOD ROAD • SOUTHINGTON • CONNECTICUT 06489 • UNITED STATES OF AMERICA
TEL: +1 (413) 875 5049 • +1 (631) 8280234 • Email: hanibaltayeh@gmail.com

EDUCATION

- **College of Engineering, University of Baghdad, Iraq.** B.S. in Chemical Engineering, 1988; B.S. Thesis: Modern Manufacturing of Methanol
- **Functional Equivalent: M.S. in Chemical Engineering, 1997** Granted by George J. Petrello, Ph.D., M.B.A., B.C.F.E.
- **Madison University**, **Gulport, MS** Master of Science in Environmental Engineering (Honors: Summa Cum Laude), 08/22/1988
- **Functional Equivalent: Doctor of Philosophy Degree in Environmental Engineering, 2001** granted by George J. Petrello, Ph.D., M.B.A., B.C.F.E – Former Dean and Professor of the School of Business Public Administration and Information of Science at Brooklyn, NY Campus of Long Island University and Associate Member of the American Association of Collegiate Registrars and Admissions offices
- **Madison University, Gulfport, MS:** Doctor of Philosophy in Environmental Engineering (Honors: Summa Cum Laude), July, 2001

PROFESSIONAL EXPERIENCE

- **GEO-SPECTROHUMANITY, LLC- APRIL 2015 UNTIL PRESENT TIME**
  FOUNDER, PRESIDENT AND CEO (FUNCTIONS AND RESPONSIBILITIES ARE SIMILAR TO THE ONES AT SPECTRUM ANALYTICAL, INC. FEATURING HANIBAL TECHNOLOGY REPORTED BELOW)

- **Spectrum Analytical, Inc. Featuring Hanibal Technology**

  2007 to 2015 - President-CEO-Treasurer-Secretary
  1995-to 2007- President-Laboratory Director – QA Officer
  1993 to 1995 - Technical Director/Quality Assurance Director
  1992 to 1993 - Quality Control Manager
  1991 to 1992 - Laboratory Analyst

Technical and Quality Assurance Profile:

Dr. Tayeh has more than Thirty (30) years of managerial, Quality Assurance/Quality Control (QA/QC) and Research and Development (R&D) experience. This included the development and implementation of various environmental analytical methods (USEPA Methods 608//8081/8082, 610/8100/8270, various volatile hydrocarbon EPA 502.2/524.2 GC/MS and Total Petroleum Hydrocarbons by GC). Dr. Tayeh developed analytical methods to identify and quantify total petroleum hydrocarbons (weathered and non-weathered fuel oils [#1, #2, #4, #6], motor/waste oils, gasoline, crude oil, and diesel) by gas chromatography (GC) in groundwater and soil using MeCl2 as a solvent extraction.

Also, Dr. Tayeh developed methods for quantitative analysis of Polynuclear aromatic hydrocarbons by gas chromatography/Mass Spectrometry (GC/MS) and polychlorinated biphenyls (PCBs) and chlorinated hydrocarbons pesticides by gas chromatography/Electron Capture Detector (GC/ECD). Dr. Tayeh performed all quality assurance/quality control (QA/QC) and method detection limit studies related to these methods and their implementation in the laboratory.

Dr. Tayeh has also developed the new MA DEP methods for petroleum hydrocarbon determination called Extractable Petroleum Hydrocarbon (EPH) and Volatile Petroleum Hydrocarbon (VPH) along with his direct involvement with the Mass DEP technical team in Lawrence and Boston, Massachusetts, to support the finalization of this particular method.

Dr. Tayeh has been invited by several New England environmental laboratories to present various aspects of new methodology being introduced to the environmental analytical field. Dr. Tayeh has perfected EPA methods with the approval and support of the Massachusetts Department of
Environmental Protection.

Business Management and Leadership:

Spectrum Analytical was founded in 1990 and staffed two employees. From 1990 until 1993, Spectrum's average annual revenue was approximately a few hundred thousand US dollars with an employment base of 4 employees.

Hanibal Tayeh was appointed as Acting Laboratory Director in 1993 and under his leadership,

Spectrum has grown to an average Seventeen Million US Dollar business and employs a staff of over one hundred and fifty professionals. He has personally expanded the geographical presence of this laboratory in both the State of Rhode Island (Warwick) and the State of Florida (Tampa) and achieved the highest quality standards through the National Environmental Laboratory Accreditation Certification (NELAC) program along with twelve other state certifications including New England, New York, and Florida.

International Business Interest

International business interests include the Major international regions. countries of Puerto Rico, Brazil, Bolivia, South Africa and most recently in both France and the Middle East Regions. Spectrum has received a soils permit from the United States Department of Agriculture (USDA) which will allow Spectrum to accept soils from other countries. Additionally, Spectrum Analytical, Inc is currently pursuing tow major projects in the Gulf region namely "The Environmental Center of Excellence which include the establishment of an environmental Testing Laboratory, Research and Development and consult advisory unit.

- **Kuwait, Iraq, 1989 - 1990: Al Hamra Kuwait Company, Kuwait City, Kuwait**
  Dr. Tayeh was responsible for waterproofing project design; management and implementation; direct client contact; and marketing. He was appointed as director of AL Hamra Kuwait branch in Baghdad-Iraq (1990)

- **BEIRUT, LEBANON, 1988 - 1989-KASSAB-MAROUN COMPANY, BEIRUT, LEBANON**
  Dr. Tayeh's responsibilities included research and development (R&D); and was in charge of quality control (QC) programs to maintain the highest quality standards of the company's plastic production. He conducted exclusive training sessions for the employees (Technicians and Engineers) during his employment regarding the day-to-day quality management followed by several internal audits to ensure the proper implementation of various critical quality procedures.

FORENSIC GEO-CHEMISTRY STUDIES

- "Petroleum Forensic Study" with Dr. Dahmani and Dr. Xie, for ECS, MA (SA22743-April 13, 2005)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA25996-May 3, 2005)
- "Petroleum Forensic Study" with Dr. Dahmani, for TEC, MA (SA25534-May 2005)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, FL (SA31197-August 2005)
- "Petroleum Forensic Study" with Dr. Dahmani, for Lessard Environmental, MA (SA29530-November 7, 2005)
- "Petroleum Forensic Study" with Dr. Dahmani, for CEA, MA (SA36094-Nov 2005)
- "Petroleum Forensic Study" with Dr. Dahmani, for Lessard Environmental, MA (SA37176-December 23, 2005)
- "Petroleum Forensic Study" with Dr. Dahmani, for CEA, MA SA38134-(Jan 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for CEA, MA (SA38802-March 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, NH (SA40727-March 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA41503-March 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for Posternak, Blankstein & Lund, LLP, MA (SA36739-May 12, 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA43746-May 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for Response Environmental, MA (SA41225-41571-43482-May 22, 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for Analytical Engineering, MA (SA45399-June 5, 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for CMG, MA (SA35874-36119-36331-37139-37899-37719-June 30, 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA47357-July 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA20449-July 2006)

- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA45872-July 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for CEA, MA (SA44995-July 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA46734-July 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for Response Environmental, VT (SA47102-July 26, 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for Environmental Services, CT (SA46865-July 31, 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SA48115-August 2006)
- "Petroleum Forensic Study" with Dr. Dahmani, for First Environmental, NJ (SB06700-01-February 26, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for AECOM, MA (SB04206-01 &-02; SB04385-01; SB09763-01-June 25, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for Engineering and Land Planning Associates, NJ (SB12428-01-June 29, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for AECOM, MA (SB11555-July 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for First Environmental, NJ (SB13974-01-August 4, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for First Environmental, NJ (SB14617-01-August 5, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for Woodard & Curran, NY (SB15726-01-August 18, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for Greenpeace, DC (SB18799-01-October 22, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for Commonwealth Tank, Inc., MA (SB01841-01-October 27, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for ECS, MA (SB21060-01 & -02-December 6, 2010)
- "Petroleum Forensic Study" with Dr. Dahmani, for Advanced Environmental Technologies, FL (SB23750-01 & -02-March 4, 2011)
- "Petroleum Forensic Study" with Dr. Dahmani, for TYREE, MA (SB24602-01 & -02-March 11, 2011)
- "Petroleum Forensic Study" with Dr. Dahmani, for AECOM, MA (SB24626-01; SB24699-01 & -02-March 16, 2011)
- "Petroleum Forensic Study" with Dr. Dahmani, for Engineering and Land Planning Associates, NJ (SB24935-01-March 23, 2011)
- "Petroleum Forensic Study" with Dr. Dahmani, for First Environmental, NJ (SB24638-01-May 2, 2011)

RESEARCH AND DEVELOPMENT

1. *"Modern Manufacturing of Methanol"*, University of Baghdad, 1988

2. *“Total Petroleum Hydrocarbon by Gas Chromatography*
a. *Modified EPA 8100”*, Spectrum Analytical, Inc., Massachusetts, 1992

3. *“TPH Modified EPA 8015 Method by Purge and Trap”,* Spectrum Analytical, Inc., Massachusetts, 1992.

4. “*Volatile Organic Methods by EPA 502.2 and SW846 8021”,* Spectrum Analytical, Inc., Massachusetts, 1992.

5. *“Total PCBs and Pesticides by Gas Chromatography SW846 8081-8082A Methods”,* Spectrum Analytical, Inc., MA, 1993.

6. *“Total Poly-Nuclear Aromatic Hydrocarbon (PAHs)* by Gas Chromatography GC/FID and Mass Spectrometry (GC/MS)- SW846 8100/8270 Methods”, Spectrum Analytical, Inc., MA, 1993.

7. *“Quality Control/Quality Assurance Plan-QA/QC”,* Spectrum Analytical, Inc., Massachusetts, 1994.

8. *“Feasibility and Efficiency of Petroleum Hydrocarbon Dating Preliminary Study”,* October, 1997.

9. *“Excerpts adopted by the Massachusetts Department of Environmental Protection* from two letters presented by Spectrum Analytical, Inc., 10/21/97 and 2/27/98 regarding the development of the MA Volatile Petroleum Hydrocarbon and Extractable Petroleum Hydrocarbon Method”.

10. *“Volatile Petroleum Hydrocarbons (VPH) MA DEP Method”,* Spectrum Analytical, Inc., Agawam, Massachusetts, 1996, Revisions 1998-1999.

11. *“Extractable Petroleum Hydrocarbons (EPH) MA DEP Method*, Spectrum Analytical, Inc., Agawam, Massachusetts, 1996, Revision 1998-1999.

12. *“Micro-Extractable Method by EPA Method 504.1”,* Spectrum Analytical, Inc., 1999.

13. *“Semi-Volatile Organic Hydrocarbons by EPA Method 8270”,* Spectrum Analytical, Inc., 1999.

14. *“Total Petroleum Hydrocarbon Technique (TPHT): Overview, Interferences -Constraints and New Development of Alternative Analytical Methods”,* 2000-2001. This study was presented in the fourth international water conference (ARWATEX-4) in Beirut on June 2005

15. *“Variations in Analytical & Physical Parameter Values Observed Due to Changes in*

Sampling Methodology and Holding Times", Joint investigation conducted by Spectrum Analytical, Environmental Compliance Services and the Department of Civil and Environmental Engineering at the University of Massachusetts in Amherst, into the causes of variability observed in field screening and analytical data at sites undergoing frequent groundwater monitoring.

16. *Evaluation of Shot-Shell Shot Pellets Impact in Soil:* Physical Separation and Lead Content Determination", Joint Investigation with MA DEP –Western Region (June 2000).

17. *"Evaluation of MTBE in Middle Distillate Petroleum Products in the Northeastern United States",* Joint Research conducted by Edward J. Hinchey, Jon Fox and Hanibal Tayeh. This technical evaluation was accepted for the "National Focus Conference MTBE in Ground Water" in Maryland (June 2001).

18. *"The Effect of Coal Tar on Geo-Memberane/Geo-Synthetic Clay Liners in Coal Tar Impacted Soil;* Adam P. Chen, Joe A. Chittet, Joel D. Krueger, Joan V. Gonzalez, Burns & McDonnell Engineering, Inc, Amine Dahmani, Ph.D, Hanibal Tayeh, Ph.D, Spectrum Analytical, Inc.,"

19. *"Conceptual Designs for Establishment of Hanibal Technology Suitability Model and the New Beach Restoration Technology".* This paper was presented at the Union of Nigerians Engineers and Scientists from France (UNESF) on July 11, 2008 in the UNESCO-Main Auditorium-Paris

TECHNICAL SEMINARS

Dr. Tayeh has presented several seminars in his professional career. They are listed below:

1- US PetroChemical Materials in the Middle East Market, Baghdad, Iraq,1990. This seminar was in response of marketing strategies for Chem-Stab, Inc., NY, NY. The seminar also generated information concerning chemicals, such as: Permabind; emulsion sealer; plush sealer; dirt sealer; cement-concrete additives/admixtures; seepage Inhibitor; slope conditioner, called "aquatain"; soil life; minezyme; super cleaner; de greaser; sewage conditioner; and cutrine (family).

2- Volatile Petroleum Hydrocarbon and Extractable Petroleum Hydrocarbon, Massachusetts, 1996-1997. Dr. Tayeh was invited to present this seminar to the Western Massachusetts Licensed Site Professional Association, Westfield, MA, December, 1996; and Fugro-ENSR, Northborough, MA, March, 1997. This seminar involved in formation concerning: background and historical overviews; distinction between EPH/VPH and corresponding EPA methods; aged petroleum products.

3- EPA Environmental Methodologies and Sample Handling, Holding Time and Preservation, Corporate Environmental Advisors, Inc. (CEA), Worcester, MA, 1997 and ENSR International, Northborough, MA ,1997

4- Feasibility and Efficiency of Petroleum Hydrocarbon Dating, Environmental Compliance Services, Inc. (ECS), Agawam, MA, 1997

5- Quality Assurance and Quality Control: Interpretation and Validation, CDW Consultants, Inc., Framingham, MA, 1998 and SMC, Inc. Bethlehem, CT, 1998

6- Introduction to the Environmental Testing Field, James Clark Public School, First and Second Grade Students, 1998, Agawam, MA.

7- Evaluation of Various Petroleum Hydrocarbon Methodologies, GroundWater Environmental Services, Inc. (GES), Windsor Locks, CT, 1999.

8- The Use of Various Environmental Analyses: Efficiency and Sample Handling, ERM, Framingham, CT, 1999.

9- Quality Management and Leadership Impact in the Environmental Industry. MI, 1999

10- Total Petroleum Hydrocarbon: Method Efficiency; Fingerprinting, Weston & Sampson, Peabody, MA, 2000.

11- Total Petroleum Hydrocarbon Technique (TPHT): Overview, Interferences-Constraints and New Development of an Alternative Analytical Methods, University of Massachusetts, Amherst, MA, 2000 (This method is under development; remains strictly confidential; possible future endorsement by the EPA), 1999-2001

12- Total Petroleum Hydrocarbon Technique (TPHT): Data Accuracy, Fingerprinting and Dating, Various Clients in the Boston Metropolitan Area (This method is under development; remains strictly confidential possible future endorsement by the EPA), 1999-2001

13- Water Quality and Monitoring Seminar, in conjunction with the Massachusetts Department of Environmental Protection, Presented to Western Massachusetts Public Water Supply personnel, 2002.

14- The New Beach Restoration Technology: Sand-RX, in conjunction with Sable D'Or team, presented to Ecology team of the Poitou-Charentes in Rochelle, France on June 2008.

PROFESSIONAL AND COMMUNITY AFFILIATIONS

- Founder and President of Hanibal Technology, LLC (2001)

- Founder of The New Culture of Peace Philosophy "Humanity Attainment Theory"

- MIT Coordinator of both International Programs "MIT BLOSSOMS and MIT LINC (Learning International Networks Consortium" in Lebanon and the Middle East.

- Leading Coordinator of an International Academic Initiative between the University of Massachusetts-Amherst *(UMASS)* and The Lebanese American University *(LAU)* with respect to Implanting both the Environmental Sciences program-laboratory and the Legal Studies programs in the LAU Campuses in the Middle East.

- Stockbridge School of Agriculture, University of Massachusetts, Amherst, MA 2001 Invitation to Serve as Chairman of a Reinstatement of the Environmental Technology option and Obtained an Adjunct rofessorship to Stockbridge School of Agriculture.

- Environmental Sciences, University of Massachusetts, Amherst, MA 2005 through 2007- Obtained an Adjunct Professorship to the Environmental Sciences Department.

- ARAB HEALTHY WATER ASSOCIATION, 2004 Member of The ABROAD ADVISOR and EXPERT CONSULTANCY Committee

- Civil & Environmental Engineering Advisory Board, University of Connecticut, Storrs, CT 2005-Member of the Board of the Department of Civil and Environmental Engineering

- Member of American Chemical Society, November, 1998

- Member of International Society of Environmental Forensics (ISEF)

- Honoree Member of the Union of Nigerian Engineers and Scientists from France (UNESF)

PERSONAL COMMUNIQUÉ

Pope John Paul II, Vatican City, Rome, Italy, 2001 *Received an Honorable Letter from the Pope John Paul II in response to the correspondence that was written by Dr. Tayeh to the Pope, translated into Polish, verbalizing Dr. Tayeh's human philosophy concept referencing the Culture of Peace. This letter was also published in Arabic and was provided to three other major powers; namely, His Beatitude Cardinal Nasrallah Boutros-Spheir-Patriarcat Maronite; His Beatitude Patriarch Ignatius IV, Hazim-Patriarcat Orthodox; and His Holiness Pope Shenouda III, Coptic Orthodox Church.*

INTERNATIONAL BUSINESS PROFILE

Dr. Tayeh's Humanity Attainment Theory was the driving force behind the development of his international philosophical and business network. This process led to the following intellectual engagement with:

President Robert Mugabe- The president of the Republic of Zimbabwe who appointed Dr. Tayeh in 2010 the General Director of the Global Project in Zimbabwe. As a result, Dr. Tayeh developed the overall Master Plan of the Global Project entailing Refinery and Pipeline - Development and processing of various Mining Resources - Hotel and 20,000 Apartment Units - Development of Tele-Communication System - Establishment of Environmental, Oil and Material Testing Laboratories and Development of Water and Agriculture System.

Dr. Tayeh has also completed Six Feasibility studies and successfully received Two Letter of Support from the ***US Administration*** especially from ***His Honorable Senator John Kerry***, The Chair of the Foreign Affairs Committee at the US Congress (2012) and ***His Honorable State Senator Michael Knapik*** of Massachusetts (January 2012).

Additionally, A New US Company "Storm Bridge Holding Company- USA, LLC was formed in the State of Massachusetts for the purpose of managing the overall project logistics according to the US Standards.

- ***President Segolene Royal***- The Chairman of the Socialist party in France-President of Poitou-Charentes Region-May 2008 who supported Dr. Tayeh for the implantation Spectrum Technology and his beach restoration technology in that region followed by a letter of intent.
- ***Madame Michele GENDREAU-MASSALOUX*** –President Sarkozy's Director of the Union of the Mediterranean (Recteur de la Francophonie)-Elysee Palace-Paris June 2008 who sponsored Dr. Tayeh for an active role in the GID and the Union of the Mediterranean
- ***Senator Jean Francois Le Grand***-Paris July 2008, who supported Dr. Tayeh's scientific and technical objectives in the Manche region followed by a letter of intent (LOI)
- ***Minister Fahme Ali Al-Jowder, Minister of Works*** in the Kingdom of Bahrain June 2008, who appointed Dr. Tayeh as "The Technical Advisor" of the Tubli project followed by a letter of intent (LOI)
- ***Minister of the Environment Engineer Abdallah*** in the Sultanate of Oman-March, 2008 who supported Dr. Tayeh's vision for beach restoration followed by a letter of Intent (LOI)
- ***Chinese Environmental Leaders*** of the Environmental Monitoring Center of Jiangsu Province in Nanjing (JSEMC), the Environmental Monitoring Center of Dalian and the Chinese Research Academy of Environmental Services in Beijing (CRAES). As a result, Dr. Tayeh signed three collaboration agreements with the three Chinese parties on January 2006.
- ***The Kingdom of Saudi Arabia Leaders***: Royal Princes; Ministers; Many Mayors especially in the Eastern Province Municipalities; Many Official Agencies (Consumer

Protection Association; Cooperative Societies Council) and Many Academic Authorities (King Saud University President).

PROFESSIONAL RECOGNITION

- ✓ Twenty (20) "*SUPPER SIXTY*" awards presented by the Greater Springfield Chamber of Commerce for one of the fastest growing companies in Western Massachusetts.
- ✓ University of Massachusetts (UMASS) for service and support for the Environmental Sciences Program on April 10, 2003
- ✓ ARWATEX Four Conference Award was presented to Dr. Tayeh for his achievement on June 2005 in Beirut-Lebanon.
- ✓ Union of Nigerian Engineers and Scientists from France (UNESF) for Dr. Tayeh's presentation as a Keynote speaker at the "Transfer of Technologies and Co-development" conference in UNESCO-Paris July 2008. Dr. Tayeh was offered an honorary membership at the UNESF Union.
- ✓ Municipalities (The Cities of Agawam, West Springfield, and Westfield, Massachusetts) for supporting the community.
- ✓ Environmental Consulting Firms (CEA, Inc., ECS, Inc., Marin Environmental, SMC, Inc., OTO, TGG, Recon Engineering, CDW and many others) for Quality Responsiveness and providing emergency response actions and quality data deliverable.

PUBLICATIONS

1. "WHEN MY SOUL SPOKE IN MY OBLIVION" 2012
   "عندما حَكَتْ نَفْسي في غَيْبوبَتي"
   Dr. Tayeh wrote his philosophical book in 2012 in Arabic and English and incorporated His Four books in One Volume.

2. "INTRODUCTION TO HUMANITY ATTAINMENT AND THE CULTURE OF PEACE"-2011
   "ألموجز في تفسير البلوغ الانساني و ثقافة السلام"
   Dr. Tayeh wrote his philosophical book in 2010-2011 in Arabic and English

3. "A GLOW EMERGING FROM THE EPILOGUE" 2011
   "يَراعة من الخاتِمة"
   Dr. Tayeh wrote his philosophical book in 2010-2011 in Arabic and English

4. “MY SOUL'S LONGING IN HER ATTAINMENT JOURNEY” AND “MY SOUL'S TESTIMONY UNDER HER DOME” - 2012
   "من طَوايا البُلوغ على مَتْن نفسي" & "شَهادَةُ نَفْسي تحت رُواقِها"
   Dr. Tayeh wrote his philosophical book in 2012 in Arabic and translated in English

5. “THE CHARTER OF THE HUMANITY ATTAINMENT PROGRESSION (H2ACFCP) - 2012; Dr. Tayeh wrote this charter in 2012 in Arabic and translated in English

6. “Humanity Suitability Theory to the Idea and Scientific-Technical Step (Priorities & Direction); Dr. Tayeh developed the theory behind Technical, Economics and Social problems in the world, 1990 in Arabic and translated in English
7. Modern Manufacturing of Methanol, 1988

8. Evaluation of MTBE in Middle Distillate Petroleum Products in The Northeastern United States, Edward J. Hinchey, Jon Fox, and Hanibal Tayeh 2001

9. A Quantitative Evaluation of Petroleum Hydrocarbon Techniques in Groundwater: Overview, Interference-Constraints and New Development of Alternative Analytical Methods, presented at The ARWATEX 4 Conference – June 27-30, 2005 in Beirut-Lebanon

10. “THE GLOBAL, CIVILIZATIONAL AND WORD MODEL PROJECT: EXEMPLARY CHEMICAL WASTE LANDFILL; ENVIRONMENTAL LABORATORY OF EXCELLENCE; ADVANCED RESEARCH & DEVELOPMENT CENTER”

DOCTORAL DISSERTATION

Total Petroleum Hydrocarbon Technique (TPHT) – Overview, Interference-Constraints and New Development of Alternative Analytical Methods, presented to Dr. M.R. Mousighi of Madison University, Gulfport, MS-2001.

All documentation will be available upon request.

ATTACHMENT E

SAMPLE CHAIN OF CUSTODY FORM

YORK
ANALYTICAL LABORATORIES INC

York Analytical Laboratories, Inc.
120 Research Drive
Stratford, CT 06615
132-02 89th Ave Queens,
NY 11418
clientservices@yorklab.com
www.yorklab.com

Field Chain-of-Custody Record - AIR

NOTE: YORK's Standard Terms & Conditions are listed on the back side of this document. This document serves as your written authorization for YORK to proceed with the analyses requested below. Your signature binds you to YORK's Standard Terms & Conditions.

YORK Project No.

Page _____ of _____

YOUR Information	**Report To:**	**Invoice To:**
Company:	Company:	Company:
Address:	Address:	Address:
Phone.:	Phone.:	Phone.:
Contact:	Contact:	Contact:
E-mail:	E-mail:	E-mail:

YOUR Project Number

YOUR Project Name

YOUR PO#:

Turn-Around Time

- RUSH - Next Day ☐
- RUSH - Two Day ☐
- RUSH - Three Day ☐
- RUSH - Four Day ☐
- **Standard (5-7 Day)** ☐

Please print clearly and legibly. All information must be complete. Samples will not be logged in and the turn-around-time clock will not begin until any questions by YORK are resolved.

Samples Collected by: (print your name above and sign below)

Air Matrix Codes

- AI - Indoor Ambient Air
- AO - Outdoor Amb. Air
- AE - Vapor Extraction Well/ Process Gas/Effluent
- AS - Soil Vapor/Sub-Slab

Samples From

- New York ☐
- New Jersey ☐
- Connecticut ☐
- Pennsylvania ☐
- Other ☐

Report / EDD Type (circle selections)

Summary Report	CT RCP	Standard Excel EDD
QA Report	CT RCP DQA/DUE	EQuIS (Standard)
NY ASP A Package	NJDEP Reduced Deliv.	NYSDEC EQuIS
NY ASP B Package	NJDKQP	NJDEP SRP HazSite
Other:		

YORK Reg. Comp.

Compared to the following Regulation(s): (please fill in)

Certified Canisters: Batch ___ Individual ___

Please enter the following REQUIRED Field Data

Reporting Units: ug/m^3 ___ ppbv ___ ppmv ___

Sample Identification	**Date/Time Sampled**	**Air Matrix**	**Canister Vacuum** Before Sampling (in Hg)	**Canister Vacuum** After Sampling (in Hg)	**Canister ID**	**Flow Cont. ID**	**Analysis Requested**

Comments:

Detection Limits Required

≤ 1 ug/m^3 _____ NYSDEC V1 Limits _____
Routine Survey _____ Other ___________

Sampling Media

- 6 Liter Canister ☐
- Tedlar Bag ☐

Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time	Samples Relinquished by / Company	Date/Time
Samples Received by / Company	Date/Time	Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time
Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time	Samples Received in LAB by	Date/Time

YORK
ANALYTICAL LABORATORIES INC

York Analytical Laboratories, Inc.
120 Research Drive
Stratford, CT 06615
132-02 89th Ave
Queens, NY 11418
clientservices@yorklab.com
www.yorklab.com

Field Chain-of-Custody Record

NOTE: YORK's Standard Terms & Conditions are listed on the back side of this document.
This document serves as your written authorization for YORK to proceed with the analyses requested below.
Your signature binds you to YORK's Standard Terms & Conditions.

YORK Project No.

Page _____ of _____

YOUR Information	**Report To:**	**Invoice To:**
Company:	Company:	Company:
Address:	Address:	Address:
Phone.:	Phone.:	Phone.:
Contact:	Contact:	Contact:
E-mail:	E-mail:	E-mail:

YOUR Project Number

YOUR Project Name

YOUR PO#:

Turn-Around Time	
RUSH - Next Day	☐
RUSH - Two Day	☐
RUSH - Three Day	☐
RUSH - Four Day	☐
Standard (5-7 Day)	☐

Please print clearly and legibly. All information must be complete. Samples will not be logged in and the turn-around-time clock will not begin until any questions by YORK are resolved.

Samples Collected by: (print your name above and sign below)

Matrix Codes	**Samples From**	
S - soil / solid	New York	☐
GW - groundwater	New Jersey	☐
DW - drinking water	Connecticut	☐
WW - wastewater	Pennsylvania	☐
O - Oil ┆ Other	Other	☐

Report / EDD Type (circle selections)		
Summary Report	CT RCP	Standard Excel EDD
QA Report	CT RCP DQA/DUE	EQuIS (Standard)
NY ASP A Package	NJDEP Reduced Deliverables	NYSDEC EQuIS
NY ASP B Package		NJDEP SRP HazSite
	NJDKQP	Other:

YORK Reg. Comp.
Compared to the following Regulation(s): (please fill in)

Sample Identification	**Sample Matrix**	**Date/Time Sampled**	**Analysis Requested**	**Container Description**

Comments:

Preservation: (check all that apply)
HCl ___ MeOH ___ HNO3 ___ H_2SO_4 ___ NaOH ___ ZnAc ___
Ascorbic Acid ___ Other: ____________

Special Instruction
Field Filtered ____
Lab to Filter _____

Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time	Samples Relinquished by / Company	Date/Time
Samples Received by / Company	Date/Time	Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time
Samples Relinquished by / Company	Date/Time	Samples Received by / Company	Date/Time	Samples Received in LAB by Date/Time	**Temp. Received at Lab**
					Degrees C

ATTACHMENT F

CONVENTIONAL LABORATORY QA/QC

120 Research Drive
Stratford, CT 06615
203-325-1371

132-02 89th Avenue
Richmond Hill, NY 11418
203-325-1371

Quality Manual-Rev. 2.8

Reviewed by:

Lab Director
Benjamin Gulizia

Corporate Technical Director
Robert Q. Bradley

Technical Director/NY
Michelle Freeman

QA/QC Officer CT
Sarah Widomski

Date of Issue/Effective date: January 22, 2019

Revision: **2.8**

Table of Contents-York Quality Manual

Quality Manual

This Quality Manual meets the requirements of ISO 17025, ISO 9001 and NELAC. This Quality Manual is confidential and assigned as outlined below.

Issued to: ______________________

Revision History

Revision 2.0	04/30/2010	First issue rewritten quality manual
Revision 2.1	11/13/2011	Updated Org Chart and Master List of Documents
Revision 2.2	06/29/2012	Updated Org Chart and Master List of Documents
Revision 2.3	12/26/2012	Added Data Integrity Plan, Reformatted document
Revision 2.4	04/12/2013	Added Aquatic Toxicity information
Revision 2.5	07/18/2014	Updated Org Chart and Master List of Documents
Revision 2.6	10/06/2014	Updated Org Chart and Master List of Documents
Revision 2.7	07/12/2016	Updated Org Chart and Master List of Documents and added new facility, removed Aq. Tox. information
Revision 2.8	01/22/2018	Update Cover page, Org Chart, Master List of Documents, added Mgmt Review page

Controlled Copy in Canary Yellow only

1. Introduction

Purpose

This Quality Manual contains all the requirements that our laboratory uses to demonstrate our quality management system, technical competence, and valid results.

Analytical data are used for many purposes, including: compliance with regulatory requirements; determination for the presence, concentration, and movement of hazardous materials in the environment; potential effects upon or protection required for persons; and the actions necessary for disposal of treatment of hazardous materials.

Analytical data may be used to support a broader-based project involved with: site characterization and/or remediation; on-site treatment; treatment and/or disposal or health and safety protection of York personnel and the public. Data may also be produced for outside commercial testing and submitted directly to clients for their decision making. In all cases, data must be of known quality.

It is the purpose of the York Quality Assurance Program, as expressed in this Quality Systems Manual, to provide all data which are of known quality. To achieve this, a system is described which controls:

- Preservation of samples
- Receipt and handling of samples
- Processing and analyses of samples
- Analytical instrumentation
- Data verification
- Data reporting

Section 4 specifies how we demonstrate sound management and maintain client satisfaction.

Section 5 specifies how we demonstrate technical competence in our laboratory.

In addition, this Quality Manual outlines how York complies with:

- ISO 17025
- ISO 9001
- NELAC

All personnel are to take an active role in establishing, implementing, and maintaining our quality management program. We do not separate quality from our daily business. Quality cannot be something that we do just to pass audits. Quality is integrated into every facet of the decision-making process in the management of our laboratory and the science that we practice.

Distribution List

The Quality Assurance Officer (QAO) maintains the distribution list for this Quality Manual.

2. Scope

This Quality Manual facilitates:

- Recognition of technical competence for standardized methods, non-routine methods, and laboratory-developed methods we perform
- Inspection and product certification capabilities and/or services we provide
- Total quality for our administrative and technical systems
- Audits by clients, regulatory authorities and accreditation bodies
- Meeting the requirements of NELAC, ISO 17025, and ISO 9001
- Client satisfaction

3. Normative References

Reference List

ISO/IEC 17000, Conformity assessment – Vocabulary and general principles

VIM, International vocabulary of basic and general terms in metrology, issued by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP and OIML.

ISO 9001:2008 – Quality Management Systems – Requirements.

ISO 17025:2005 – General Requirements for the Competence of Testing and Calibration Laboratories.
NELAC 2003 and NELAC 2009-Quality Systems

4. Management Requirements

Section 4.0 Management Requirements

4.1 Organization

Section 4.1 Organization

This section discusses general positions and quality-related responsibilities which provide for the implementation of the Quality Assurance Program and completion of quality control activities. Also discussed is the role of the York Quality Assurance Officer.

4.1.1 Legal Identification / Registration

York Analytical Laboratories, Inc.
120 Research Drive
Stratford, Connecticut 06615
203-325-1371
Fax 203-357-0166
E-mail: ClientServices@yorklab.com

York Analytical Laboratories, Inc. (II)
132-02 89th Avenue
Richmond Hill, NY 11418
203-325-1371
Fax 203-357-0166
E-mail: ClientServices@yorklab.com

State of Connecticut Department of Health (CTDOH) Certification no. PH-0723
New York State Department of Health (NYSDOH) Certifications no. 10854 and 12058
State of New Jersey Dept. of Environmental Protection (NJDEP) Certification no. CT-005
State of Pennsylvania Registration No. 68-04440
EPA ID NO. CT-005

4.1.2 Laboratory Requirements

The departments of York Analytical Laboratories, Inc. have been organized to satisfy the needs of the Client and regulatory authorities and to meet the NELAC and international standards ISO 17025 and ISO 9001. York Analytical Laboratories, Inc. is comprised of the following Departments or Groups:

Laboratory Director's Office

Quality Assurance Group

Client Services/Sales Groups

Sample Control Group

Classical Chemistry Group

Organic Preparations Group

Atomic Spectroscopy/Metals Group

Gas Chromatography Group

Gas Chromatography/Mass Spectrometry Groups (Volatiles, Air and Semi-Volatiles)

Report production/Data Management Group

4.1.3 Scope of Management System

The management system covers activities in the laboratory's permanent facilities at 120 Research Drive, Stratford, CT 06615 and 132-02 89th Avenue Richmond Hill. NY 11418. The fields of activities include:

Analysis of environmental samples (water, wastewater, soil, sludge, and air) for Federal and State regulated contaminants in support of private clients.

The laboratory's scope of tests is listed in the our specific Certifications and encompasses volatile organics, semi-volatile organics, pesticides, herbicides, PCBs, metals, and various general chemistry parameters.

4.1.4 Potential Conflicts of Interest

York has no potential conflicts of interest since it is independently owned and operated and provides only environmental laboratory analysis services. The ownership of York does not have any other interest that would be considered a potential conflict of interest.

4.1.5 Organization

A) Management and Technical Personnel

Policy:
The laboratory managerial and technical personnel, irrespective of other responsibilities, have the necessary authority and resources needed to meet the mandates assigned to their areas.

Details:
Responsibilities are detailed in 4.1.5 (F).

Departures from the organizational and management policies in this manual can only be approved by the Laboratory Director.

Departures from quality management system procedures can only be approved by the Quality Assurance Officer or the Laboratory Director.

Departures from test methods or technical standard operating procedures (SOPs) can only be approved by the Laboratory Director. See also section 5.2.

B) Undue Pressure

Policy:
Management and personnel are to be free from any undue internal and external commercial, financial and other pressures that may adversely affect the quality of their work. The integrity of test results is the responsibility of all personnel. Management ensures that employees are never instructed or forced to alter or falsify data.

Details:
The following list provides some guidelines on how employees avoid conflict of interest situations. Employees shall not:

- falsify records, prepare fraudulent reports, or make false claims
- seek or use privileged or confidential company information, or data from any Client, for any purpose beyond the scope of employment
- conduct non-laboratory business on laboratory time, or use company facilities or instrumentation to conduct outside interests in business, unless prior approval has been obtained
- solicit business on their own behalf (rather than the laboratory) from a Client
- be employed by, or affiliated with, organizations whose products or services compete with laboratory products or services
- have employment that negatively affects or interferes with their performance of laboratory duties
- compete with the laboratory in the purchase, sale, or leasing of property or goods
- allow association, family, or friends to influence business decisions to their benefit - decisions must be made on a strictly business basis, always in the best interest of the laboratory
- make any decision that provides gains or benefits to the employee and/or others
- have personal financial dealings with an individual or company that does business with the laboratory which might influence decisions made on the laboratory's behalf

Firm adherence to this code of values forms the foundation of our credibility. Personnel involved in dishonest activities are subject to a range of disciplinary action including dismissal.

C) Client Confidentiality

Policy:
It is the policy of our laboratory to protect the confidential information and proprietary rights of our Client including the electronic storage and transmission of results.

Details and Procedures:
All employees sign an Employee Confidentiality Agreement. The signed agreement is retained in each employee's Human Resources file.

Test results are only released to the Client. Release to someone other than the Client requires the express permission of the Client, except when the situation contravenes State or Federal Legislation and the results must be provided to the appropriate agency. The release of test results to anyone other than the Client requires the permission of the Client and management. Laboratory reports are reviewed for accuracy and completeness prior to release.

D) Operational Integrity

Policy:
The laboratory will avoid involvement in any activities that would diminish confidence in its competence, impartiality, judgment, or operational integrity.

Details and Procedures:
To ensure confidence in laboratory operations a formal quality assurance program is implemented. Technical competence is ensured through check sample programs. Impartiality is assessed through audits and approvals. Judgment is ensured through the hiring of qualified personnel and by continuously refining, upgrading, and improving his or her skills. Operational integrity is reviewed by management on a regular basis at management review meetings to ensure continued suitability and effectiveness of laboratory policies and procedures. Any problems are acted on immediately through corrective action procedures.

E) Organizational Structure

Policy:
The organization and management structure of the laboratory and the relationships between management, technical operations, support services, and the quality management system is defined through the aid of an organizational chart.

Details:
Senior management keeps the most current organizational chart on file. An organizational chart is available with this manual as a reference record-ATTACHMENT A and is considered the official record on the date it is marked in the lower right corner.

F) Responsibility and Authority

Laboratory Director

- develops primary goals, operating plans, policies, and short and long range objectives for the laboratory; implements these following Board of Directors' approval
- directs and coordinates activities to achieve profit and return on capital
- establishes organizational structure and delegates authority to subordinates
- leads the laboratory towards objectives, meets with and advises other executives, and reviews results of business operations; action plans to meet the needs of stakeholders
- represents organization to major Clients, government agencies, shareholders, and the public as necessary
- is knowledgeable of the scope of all processes under supervision
- provides the necessary resources (personnel, instrumentation, supplies) for the quality assurance program, in order to ensure confidence in the laboratory's results
- ensures instrumentation is maintained and calibrated, reporting all deficiencies (e.g., instrumentation malfunctions) in the appropriate manner
- maintains current job descriptions
- maintains records and manages all aspects of testing activities

Technical Director

- Technical responsibility for SOP preparation to reflect method requirements
- New Procedural implementations
- Assessing SOP modifications before implementation
- Staying current with regulatory needs relative to Technical Procedures
- Staff training
- New Technology recommendations/implementations
- Technical troubleshooting for all areas of the laboratories

Quality Assurance Officer (QAO)

- ensures that the Quality Management System is established, implemented and maintained in accordance with the ISO 9001, ISO 17025 and NELAC standards
- manages the internal audit program; coordinates lab accreditation activities
- handles the maintenance and distribution of the Quality Manual and associated documents
- maintains a master list of current versions of quality documentation
- trains personnel on Quality Management System activities
- monitors the Quality Management System
- reports on the performance of the Quality Management System to senior management for review and as a basis for improvement of the Quality Management System
- supervises the laboratory's double-blind proficiency testing program

Group Leaders

- responds to York Client Services Group inquiries and provides professional advice
- hires personnel with Laboratory Director
- orientates new personnel

- determines technical training needs of personnel
- conducts employee performance reviews
- schedules vacation and coverage
- ensures that all health and safety regulations are followed
- ensures that all Human Rights Legislation are complied with
- prioritizes workload
- facilitates operational concerns in their area
- ensures accurate and consistent testing procedures through the validation of all current procedures and by developing, validating and implementing new procedures
- coordinates purchasing requests
- ensures that the operational needs are within budget and advising management of any discrepancies

Analysts and Technicians

- maintains records of all quality activities as documented in SOPs and test methods
- handles samples and performing analyses according to SOPs and test methods
- provide input and assists in preparation of SOPs and test methods
- maintain and calibrate instrumentation and instrumentation
- reports deficiencies or malfunctions to the Group Leader
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and recording potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities
- improves laboratory and/or quality activities on a continuous basis

Project Managers/Client Services

- provides vision and direction for analysis activities
- Responds to Clients' and provides professional advice
- develops and reviews proposals/Quotations
- Reviews Quality Assurance Project Plans for Clients
- monitors the progress of Work-in-Process
- reviews reports for selected Clients
- oversees, standard pricing, customized quotations, and invoicing for tests performed
- controls the flow of communication between the Client and the laboratory

Administrative/Data Management Personnel

- performs work functions and keeps records as per approved SOPs and/or laboratory policies
- generate final reports, invoices and data packages for transmittal to Clients
- assist in preparation of SOPs
- identifies and records nonconformities on *Corrective Action Reports*
- identifies and records potential nonconformities on *Preventive Action Requests*
- corrects nonconformities and potential nonconformities

- improves laboratory and/or quality activities on a continuous basis

G) Laboratory Supervision

Policy:
Adequate supervision is provided in each area of the laboratory for all testing and calibration personnel, including trainees, by persons familiar with the methods and procedures.

Details:
Adequate supervision is ensured through designated supervisors as well as through documentation such as this Quality Manual, test methods and SOPs. A thorough orientation and training program is adhered to for all new employees. Ongoing training for regular personnel is required.

H) Technical Management

Policy:
A Group Leader is assigned to each major technical department of the laboratory. They have overall responsibility for the technical operations and the provision of resources needed to ensure the required quality and production of laboratory operations.

Details:
While the Group Leader may at times delegate duties to other personnel, the Group Leader is accountable for any nonconforming activities.

I) Quality Assurance Officer

Policy:
The Quality Assurance Officer is appointed by the highest level of management. The Quality Assurance Officer, who, irrespective of other duties and responsibilities, has defined responsibility and authority for ensuring that the management system related to quality is implemented and followed. The Quality Assurance Officer has direct access to the highest level of management where decisions are taken on laboratory policy or resources.

Details:
This statement notifies all laboratory personnel that Sarah Widomski is the Quality Assurance Officer as authorized by the Laboratory Director. Any change in this position requires the reissue of this section to all holders of controlled copies of the Quality Manual. The following signature also serves as approval for this Quality Manual and affirms senior management's commitment to the policies and procedures set forth in this manual.

J) Managerial Substitutions

Policy:
Deputies for key personnel are appointed to fulfill the key personnel's duties in their absence.

Details:
In the absence of the Quality Assurance Officer, the Technical Director or Laboratory Director will assume his/her responsibilities.

In the absence of the Group Leader, the Laboratory Director, a Technical Director or other Group Leader will assume his/her responsibilities.

Management is responsible for ensuring that current and/or increased workload requirements are met. This includes making adjustments as a result of employee absence. Only fully trained employees are utilized to fulfill the duties of personnel who are absent. If sufficient human resources are not available, management will identify the best possible solution to meet operational requirements.

K) Awareness

Policy:
Management ensures that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the objectives of the management system.

Details:
Supervisors review the details of each employee's job description with the appropriate employee and how the overall Quality Policy Statement (Section 4.2.2) relates to their activities to achieve the objectives of the management system.

4.1.6 Communication Processes

Policy and Details:
Top management ensures that appropriate communication processes are established within the laboratory and that communication takes place regarding the effectiveness of the management system.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	11/14/2011	Changed QA Officer name to Teresa Weikel
Revision 2.2	10/06/2014	Changed Acting QA Officer to Robert Bradley
Revision 2.3	07/12/2016	Changed QA Officer name to Magdalena Szymczuk
Revision 2.4	04/15/2017	Changed QA Officer to Aaron Patak, then S.Widomski
Revision 2.5	01/10/2019	Changed York/NY Tech. Dir/QA to Michelle Freeman

4.2 Management System

4.2.1 Policies and Procedures

Policy:
The Quality Management System is established, implemented, and maintained by management. It is applicable to all the fields of testing and activities in which the laboratory is involved and undertakes. All policies, systems, programs, procedures and instructions are documented to the extent necessary to enable the laboratory to assure the quality of results generated. These documents are communicated to, understood by, available to, and implemented by the appropriate personnel.

Details:
The purpose of our Quality Management System is to ensure that all services and products satisfy the Client's requirements and have been designed, manufactured, and delivered under controlled conditions.

The effectiveness of the Quality Management System is assessed in several ways:

- by a program of planned internal audits, covering all aspects of the operation of the quality management system
- by regular management reviews of the suitability and effectiveness of the quality management system
- by analysis of potential and actual problems as shown by Client complaints and supplier and subcontractor assessments
- by other methods approved from time to time by the Laboratory Director

This Quality Manual and associated documents (including procedures) and records serves as the quality plan for the laboratory. Other documents and records include:

- standard operating procedures
- quality control plans in test methods
- organizational charts
- proposals and Quality Assurance Project Plans (QAPP)
- project management schemes

4.2.2 Quality Policy Statement

Policy:
The policies and objectives for laboratory operations are documented in this Quality Manual. The overall objectives are set out in the Quality Policy Statement and reviewed during management review. The Quality Policy Statement is issued under the authority of the Laboratory Director on the effective date.

Quality Policy Statement:
To ensure accurate and timely environmental laboratory analysis services and to continuously meet or exceed the stated or implied expectations of our Clients through day-to-day interactions.

Effective Date: April 30, 2010

a) *Management commitment to good professional practice and quality of services provided to the Client*: analyses and calibrations are always carried out in accordance with stated standardized methods and Clients' requirements. Requests to perform tests that may jeopardize an objective result or have a low validity are rejected.

b) *Standards of service include*:

- ➢ Client Satisfaction
- ➢ Quality
- ➢ Timeliness

Excellence in the workplace is promoted by providing all employees with the knowledge, training, and tools necessary to allow for the completion of accurate and timely work.

c) *Purpose of management system related to quality*: to manage our business by meeting the needs of our Clients.

d) *Personnel*: familiarize themselves with quality documentation and implement the policies and procedures in their work.

e) *Management is committed to complying with NELAC, ISO 17025 and ISO 9001 international standards and to continually improve the effectiveness of the management system*: the objective of this Quality Manual is to document the compliant policies and associated procedures that are integrated into our daily activities. Continual improvements are established, implemented, and integrated into the management system. Additional objectives include:

- to establish the level of the laboratory's performance
- to make test method changes to improve performance within regulatory guidelines
- to participate in proficiency testing or quality evaluation programs with regulatory bodies
- to ensure that all personnel are trained to a level of familiarity with the quality management system appropriate to the individual's degree of responsibility
- to improve and validate laboratory methodologies by participation in method validation collaborative tests, where applicable

4.2.3 Commitment to the Management System

Policy:
Top management is committed to the development and implementation of the management system and continually improving its effectiveness.

Details:
The results of the management system are regularly reviewed during management review (see Section 4.15) and continual improvements are made as outlined in Section 4.10 – Improvements.

4.2.4 Communication of Requirements

Policy:
Top management communicates to the organization the importance of meeting Client requirements as well as statutory and regulatory requirements.

Details:
In general, the underlying message in all oral and written management communications involves meeting the aforementioned requirements. Meeting Client requirements ensures that ongoing business relationships secure the contracts that keep everyone employed. Meeting statutory and regulatory requirements ensures that laboratory operations will not be disrupted and the organization can continue to meet Client needs.

4.2.5 Quality Manual

Policy:
This Quality Manual outlines the structure of the documentation used in the quality management system. This Quality Manual makes reference to supporting procedures including technical procedures and is maintained up to date.

Details:
This quality management system is structured in three tiers of documentation. The tiers are as follows:

1. Quality Manual
2. Standard Operating Procedures and Reference Methods
3. Records

For most Clients, this Quality Manual and the associated documents form a general Quality Plan. If necessary, specific Quality Assurance Project Plans (QAPP) will be prepared on a ‘per-Client’ basis. These QAPPs will modify the general requirements stated in the Manual and associated documents.

All of the above documents are controlled documents in yellow only.
The following records and directive documents are referenced in the Quality Manual, but maintained separately:

- copies of the Quality Policy Statement posted in the laboratory (section 4.2.2)
- identification of resources and management review (section 4.15.1)
- job descriptions (section 5.2.4)
- statistical techniques (section 5.9)
- test reports (section 4.13.2 and 5.10)
- identification of the laboratory’s approved signatures (section 5.10.2)
- laboratory’s scope of tests (section 4.1.3)
- instrumentation inventory and records (sections 5.5.4 and 5.5.5)
- calibration status indicators (section 5.5.8)
- reference standards inventory (section 5.6.3)
- verification records (section 5.9)
- quality control plan / criteria for workmanship (section 5.4.1)
- corrective action records (section 4.11)
- preventive action records (section 4.12)
- client complaint records (section 4.8.1)
- audit schedule and records (section 4.14.3)
- procurement and subcontracting records (sections 4.6 and 4.5.4)

- training records (section 5.2.5)
- master list of documentation (section 4.3.2)
- confidentiality agreements (section 4.1.5 C)
- contract review (section 4.4.2)
- validation of test methods (section 5.4.5)
- facility floor plans (section 5.3.1)

4.2.6 Technical Management and the Quality Assurance Officer

4.2.7 The roles and responsibilities for technical management (Group Leaders) and the Quality Assurance Officer are outlined in section 4.1.5 (F) of this manual.

Technical management (Group Leaders) ensures that section 5 of this manual is implemented and maintained. The Quality Assurance Officer ensures that section 4 of this manual is implemented and maintained.

4.2.8 Maintenance

Policy and Details:
Top management ensures that the integrity of the management system is maintained when changes to the management system are planned and implemented.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	11/14/2011	Changed QA Officer name to Teresa Weikel
Revision 2.2	10/06/2014	Changed Acting QA Officer to Robert Bradley
Revision 2.3	07/12/2016	Changed QA Officer name to Magdalena
Revision 2.4	04/15/2017	Changed QA Officer to Aaron Patak, the S. Widomski
Revision 2.5	01/10/2019	Changed York/NY Tech. Dir/QA to Michelle Freeman

4.3 Document Control

Policy: The SOP# ADMINDOC043010 is used to control all quality management system documents. These may include documents of external origin, such as regulations, standards, other normative documents, test and/or calibration methods, as well as drawings, specifications, instructions, and manuals.

Details:
Document means any information or instructions including policy statements, procedures, specifications, calibration tables, charts, text books, posters, notices, memoranda, software, drawings, and plans. These may be in various media, whether hard copy or electronic and they may be digital, analog, photographic or written.

The documents to be controlled include:
- Quality Manual
- Standard Operating Procedures
- Forms
- Standards

The control of data related to testing and calibration is covered in section 5.4.7. The control of records is covered in section 4.13.

4.3.1 Document Approval and Issue

4.3.1.1 Review / Approval / Master List

Policy and Details:
All documents issued to personnel in the laboratory as part of the quality management system are reviewed and approved for use by authorized personnel prior to issue (i.e., reviewed by personnel knowledgeable in the documented activity and then approved by management). A master list identifying the current revision status and distribution of documents in the quality management system is readily available in order to preclude the use of invalid and/or obsolete documents (see SOP# ADMINDOC043010). A revision history of documents is also maintained. Documents are formally reviewed on a biennial basis to ensure their continuing suitability. APPENDIX B contains a current Master List of Documents.

4.3.1.2 Availability and Obsolete Documents

Policy and Details:
The master list includes all current controlled documents. The master list document is organized with the following information:

- Description
- SOP Number
- Date of Issue (effective date of each procedure)
- Revision Number
- Date of Revision (effective date of each current revision)

Controlled documents are approved before issue.

The SOP# ADMINDOC043010 for document control ensures that:

- authorized editions of appropriate documents are available at all locations where operations essential to the effective functioning of the laboratory are performed
- documents are periodically reviewed and where necessary revised to ensure continuing suitability and compliance with applicable requirements
- invalid or obsolete documents are promptly removed from all points of issue or use to assure against unintended use
- obsolete documents retained for either legal or knowledge preservation purposes are suitably marked (i.e., stamped "OBSOLETE" and dated)

4.3.1.3 Identification

Policy and Details:
All quality management system documentation is identified by:

- date of issue and/or revision number
- page numbering
- total number of pages (e.g., page 5 of 5)
- issuing authority (i.e., approval signature)

4.3.2 Document Changes

4.3.2.1 Review / Approval

Policy:
Changes to documents are reviewed and approved by the same function (i.e., personnel or position) that performed the original review unless specifically designated otherwise.

Details:
Developments in policies and procedures require documents to be changed from time to time. Changes to documents receive the same level of review and approval as the originals.

The Quality Manual is reviewed annually by the Quality Assurance Officer. Records are kept of this review.

Test methods and SOPs are reviewed on a biennial basis. Procedures for this are outlined in SOP# ADMINDOC043010.

Obsolete documents are withdrawn, but are retained for archive purposes and clearly labeled as obsolete.

4.3.2.2 Identification of Changes

Policy:
The nature of document changes is identified in the document.

Details:
As outlined in SOP# ADMINDOC043010.

In general, the nature of changes is described in the document. Revision history is recorded at the end of the document.

4.3.2.3 Amendments by Hand

Policy and Details:

Hand-written amendments are clearly marked, initialed, and dated by the Laboratory Director and/or the QA/QC Officer on all controlled yellow copies.

4.3.2.4 puterized Documents

Policy and Details:
The SOP# ADMINDOC043010 details how changes in documents maintained in computerized systems are made and controlled.

Revision History

None

4.4 Review of Requests and Contracts

4.4.1 Policies and Procedures

Policy:
The SOP AMINCONTRACT043010 is used to review requests or contracts. This procedure ensures that:

a) the Client requirements including the methods to be used are adequately defined, documented and understood (see section 5.4.2)
b) the laboratory has the licensing, capability and resources to meet the requirements
c) the appropriate testing method is selected and capable of meeting the Client's requirements or data quality objectives (see section 5.4.2)

Any differences between the request and the contract are resolved before any work commences. Each contract must be acceptable by both the laboratory and the Client.

Details:
The request and contract review is conducted in a practical and efficient manner, and the effect of financial, legal, and time schedule aspects are taken into account.

The review of capability establishes that the laboratory possesses the necessary physical, personnel, and information resources, and that the laboratory's personnel have the skills and expertise necessary for the performance of the tests in question. The review may also encompass results of earlier participation in inter-laboratory comparisons or proficiency testing and/or the running of trial test using samples or items of known value in order to determine uncertainties of measurement, limits of detection, and confidence limits.

The contract review ensures that each Client's requirements are adequately defined and documented before the service or product is ordered or dispatched. This should ensure that any order, once accepted, can be completed without delay, and that the Client's requirements including delivery date, technical specification, and cost can be met.

If the contract review highlights any ambiguities or uncertainties then the Client will be contacted and the problem resolved before the order is accepted.

The SOP AMINCONTRACT043010 also describes the activities that take place should there be a subsequent amendment to a Client's order.

Typical types of contracts include:

- approved service quotations
- confidentiality agreements
- non-disclosure agreements
- sample submission requests
- memorandum of agreement
- memorandum of understanding
- research proposals and contracts
- verbal orders (oral agreements)
- activity plans

4.4.2 Records of Review

Policy:
Records of request and contract review, including significant changes, are maintained. Records of pertinent discussions with a Client relating to the Client's requirements or the work during the period of execution of the contract are also maintained.

Details:
For review of routine and other simple tasks, the date and the identification (e.g., initials) of the person in the laboratory responsible for carrying out the contracted work are considered adequate. For repetitive routine tasks, the review need be made only at the initial enquiry stage or on grant of the contract for on-going routine work performed under a general agreement with the Client, provided that the Client's requirements remain unchanged. For new, complex or advanced testing tasks, a more comprehensive record is maintained.

4.4.3 Review of Subcontracted Work

Policy:
Request and contract review also includes work that is subcontracted by the laboratory.

Details:
Subcontractor laboratories are reviewed as described in section 4.5.

4.4.4 Notification of Client

Policy and Details:
Clients are informed of deviations from the contract. This is typically communicated to the Client prior to the performing the deviation or disclosed in the final report narrative or qualifiers.

4.4.5 Contract Amendment

Policy and Details:
If a contract needs to be amended after the work has commenced, the same contract review process is repeated and any amendments are communicated to all affected personnel.

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual

4.5 Subcontracting of Analyses and Calibrations

4.5.1 Subcontractor Competence

Policy:

Work that must be subcontracted due to:

- unforeseen circumstances, instrument or QC failures
- workload
- large contracts
- contracts requiring some extra technical expertise
- Tests not performed in-house

is subcontracted to a technically competent laboratory.

Details:

The subcontracted laboratory demonstrates technical competence by possession or receipt of one or more of the following:

- recognized technical accreditation- NYSDOH NELAC or other NELAC accreditation body or other certification where applicable
- satisfactory performance of appropriate quality control check samples, certified reference material, in-house reference material or replicate analysis-NELAC labs do not need this documentation
- Review of the subcontractor’s quality management system by our QA Officer

It is the responsibility of the Quality Assurance Officer to assess and approve the competence level of subcontractor laboratories with particular attention to their certifications which are maintained in the Quality Assurance network drive.

4.5.2 Client Approval

Policy:

Clients are advised of work (or any portion thereof) that is being subcontracted to another laboratory and their approval is obtained (preferably in writing). Upon log-in at the lab, a Subcontract Notification Form is generated by Sample Control and e-mailed immediately to the Client. In some cases an email record will serve this purpose.

Details:
Clients are advised of subcontracted work through fee schedules or any type of contract listed in section 4.4.1.

4.5.3 Assurance of Subcontractor Competence

Policy:
The laboratory is responsible to the Client for the subcontractor's work. Technical competence of subcontractor laboratories is demonstrated through various records.

> **Note** – there may be circumstances where the Client specifies which subcontractor is to be used. In such cases we may not be able to demonstrate the competence of the subcontractor and therefore are not responsible for the results.

Details:
Records of subcontractor competence may include, but are not limited to, the following:
- accreditation certificates or documentation
- registration certificates
- check sample results
- audit results
- approval by the Quality Assurance Officer

4.5.4 Subcontractor Register

Policy:
A register of all subcontractors performing tests is maintained in th eQuality Assurance network drive.

The approved register of subcontractors and all relevant records are maintained by the Quality Assurance Officer.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.6 Purchasing Services and Supplies

4.6.1 Policies and Procedures

Policy:
The SOP ADMINPURCHASESING043010 is used to select and purchase services and supplies. The SOP ADMINPURCHASESING043010 is used for procurement, reception, and storage of supplies. Individual method SOPs dictate the materials to use. No modification of this is allowed without athorization.

Details:
Consumable materials are stored according to the appropriate test method, SOP, or work instruction.

4.6.2 Specifications

Policy:
Only services and supplies of the required quality are used. These quality requirements are detailed in laboratory SOPs under the "*Materials Required*" section and will identify the appropriate minimum specifications when necessary.

Details:
Packing slips are checked against package content labels and matched with the Purchase Order if accepted. Once accepted, the packing slip is dated and initialed as evidence of compliance. Certificates of analysis (COA) are maintained on file after the COA is checked to ensure the received item meets minimum specifications.

Chemicals are purchased with manufacturer's certificates where possible. Uncertified chemicals are purchased from ISO 9000 registered companies where possible. Whatever the source, the laboratory verifies the quality of the standards by comparing the new batch of standards to the old. Due regard is paid to the manufacturer's recommendations on storage and shelf life.

Reagents are generally purchased from manufacturers who have a quality management system based on ISO 9000. The grade of any reagent used (including water) is stated in the method together with guidance on any particular precautions to be observed in its preparation or use.

Where no independent assurance of the quality of procured goods or services is available or the supplier's evidence is insufficient the laboratory ensures that purchased goods and services comply with specified requirements. Where possible and practical the laboratory ensures that goods are inspected, calibrated, or are otherwise in compliance with any standard specification relevant to the calibrations or tests concerned.

4.6.3 Purchasing Documents

Policy:
Purchasing requests are recorded on the Purchase Order form and contain data describing the product ordered. The Purchase Order is reviewed and approved for technical content prior to release.

Details:
The description may include type, class, grade, precise identification, specifications, drawings, inspection instructions, other technical data including approval of test results, quality required and quality management system standard under which they were produced.

The completion of the Purchase Order is the responsibility of the originator.

4.6.4 Approved Suppliers

Policy:
Suppliers of critical services are evaluated and approved before use. An approved supplier list is maintained.

Details:
Audits or tender evaluation is conducted to qualify suppliers of critical services prior to use. The criteria for evaluation may include, but is not limited to the following:

- references
- accreditation
- formal recognition

The records are maintained by purchasing personnel. **SOPs detail the acceptable vendors for all materials.**

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.7 Service to the Client

4.7.1 Service

Policy:
Client requests are clarified for the Clients or their representatives. Furthermore the Client or their representative will be afforded the right to monitor the performance of the laboratory in relation to the work performed, provided that the laboratory ensures confidentiality to other Clients.

Details and Procedures:
Service to the Client includes:

- Affording the Client or the Client's representative reasonable access to relevant areas of the laboratory for the witnessing of work performed for the Client; it is understood that such access should not conflict with rules of confidentiality of work for other Clients or with safety.

- Preparing, packaging, and dispatching of test data needed by the Client for verification purposes.

- Maintaining of open contacts. The Client values advice and guidance in technical matters, and opinions and interpretations based on results. Contact with the Client, especially in large assignments, should be maintained throughout the work by Client Services personnel. The laboratory should inform the Client of any delays or major deviations or issues encountered during the performance of the tests.

4.7.2 Feedback

Policy and Details:
The laboratory seeks feedback from the Client. Positive and negative feedback can be obtained passively through ongoing communications with the Client (e.g., review of test reports with Clients) or actively through Client satisfaction surveys. The feedback is used to improve the quality management system, testing activities, and Client service.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.8 Complaints

4.8.1 Policies and Procedures

Policy:
The SOP ADMINCOMPLAINTS 04302010 is used for resolving complaints received from Clients or other parties. Records are maintained of all complaints and follow-up.

Details:
Records of complaints include the following information:

- details of the complaint
- investigation
- corrective action
- follow-up verification

See also section 4.11.

All personnel are responsible for recording and responding to complaints.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.9 Control of Nonconforming Analyses

4.9.1 Procedures to Control Nonconforming Work

Policy:
The SOP ADMINNONCONFORM 04302010 is used to control any aspect of testing, or the results of this work, when they do not conform with the test methods, SOPs or the agreed to requirements of the Client.

Details:
The procedure ensures that:

- Responsibilities and authorities for the management of nonconforming work are designated and actions (including halting of work and withholding of test reports as necessary) are defined and taken into consideration when nonconforming work is identified
- an evaluation of the significance of the nonconforming work is made
- correction is taken immediately, together with any decision about the acceptability of the nonconforming work
- where necessary, the Client is notified and the work is recalled
- the responsibility for authorizing the resumption of work is defined

Identification of nonconforming work or problems with the quality management system or with testing activities can occur at various locations within the quality management system and technical operations such as:

- Client complaints
- quality control
- instrument calibration
- checking of consumable materials
- staff observations or supervision
- test report review
- management reviews
- internal or external audits

4.9.2 Root Cause Analysis

Policy:
Where evaluation indicates that nonconforming work could recur or that there is doubt about the compliance of the laboratory's operations with its own policies and procedures,

the corrective action procedures given in 4.11 are followed to identify the root cause(s) of the problem and to eliminate cause(s).

Details:
The SOP ADMINCORRACTION043010 outlines the recording of the root cause analysis for investigating nonconforming work.

Situations warranting corrective action investigation include:

- failure to comply with test method including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- presentation of uncertain knowledge as to compliance with test methods including all applicable procedures necessary to ensure the integrity and representative nature of the sample
- failure or suspected failure in method performance as demonstrated by results provided by quality control samples
- lack of relevant evidence provided by quality audit, proficiency testing, or Client feedback
- lack of relevant evidence provided by data validation
- neglect to check the inherent property of the sample that compromises the testing

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.10 Improvements

4.10.1 Policies and Procedures

Policy:
The laboratory continually improves the effectiveness of its management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective actions, and management review.

Details:
The laboratory has implemented a continual improvement philosophy within the management system. Every employee in the laboratory is encouraged to suggest new ideas for improving services, processes, systems, productivity, and the working environment.

Opportunities for improvement of operations and processes are identified by managers on a continual basis from ongoing feedback on operations and through management reviews. Opportunities for improvement of services are identified by anyone within the organization including Sales, Marketing and Client Services.

Inputs for improvement opportunities are obtained from the following sources:
- Client satisfaction surveys and any other Client feedback
- market research and analysis
- employees, suppliers, and other interested parties
- internal and external audits of the management system
- records of service nonconformities
- data from process and service characteristics and their trends

Opportunities for improvement may also be identified on a special project basis. The following are listed only as examples:
- improving usefulness of bench space
- reducing excessive inspection/analysis
- reducing excessive handling and storage
- reducing test/calibration failures

Opportunities for improvement from daily feedback on operational performance (i.e., internal audits, Client feedback, test/calibration failures) are evaluated by the Laboratory Director or Quality Assurance Officer. Typically, they are implemented through the corrective and preventive action system.

Opportunities for improvement from analysis of longer-term data and trends are evaluated and implemented through the management review process. They are prioritized with respect to their relevance for achieving quality objectives. When opportunities for improvement are no longer supported by the current policy and objectives, management will establish new quality objectives, and possibly change the policy. The process for this evaluation is described in Section 4.15. Longer-term improvement projects are initiated through the management review process, as well as the corrective and preventive action system.

Service improvement opportunities are evaluated by management. They are implemented through the supervisor of the laboratory who ensures that the improvements are validated as outlined in Section 5.4 of this manual and appropriate level of quality control is performed on an ongoing basis.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.11 Corrective Action

4.11.1 General

Policy:
The SOP ADMINCORRACTION043010 is utilized for implementing corrective action when nonconforming work or departures from policies and procedures in the quality management system or technical operations have been identified. The procedure requires that appropriate authority be designated for the implementation of corrective actions. The procedure includes cause analysis, selection and implementation of corrective action, and monitoring of actions.

Details:
Problems with the quality management system or technical operations of the laboratory may be identified through a variety of activities, such as control of nonconforming work, internal or external audits, management reviews, feed-back from Clients, or staff observations.

Corrective action investigations are documented and required changes to operational procedures are implemented. The corrective action request (CAR), investigation and resolution are recorded on a CAR form.

4.11.2 Cause Analysis

Policy:
Corrective action always begins with an investigation to determine root cause(s) of the problem (see SOP ADMINCORRACTION043010).

Details:
Potential causes of the problem could include Client requirements, the samples, sample specifications, methods and procedures, personnel skills and training, consumable materials, or instrumentation and its calibration.

4.11.3 Selection and Implementation of Corrective Actions

Policy and Details:

After determining the cause(s) of the problem, potential corrective actions are identified. The most likely action(s) (this includes practical and/or reasonable) are selected and implemented to eliminate the problem and to prevent recurrence. It should be noted that any corrective actions taken to eliminate the cause(s) of nonconformities or other departures are to a degree appropriate to address the magnitude of the problem and commensurate with the risks encountered (Note – in plain language, this means determine whether the benefit outweighs the cost). Controls are applied to prevent recurrence. The laboratory documents and implements the required changes resulting from corrective action investigations.

4.11.4 Monitoring of Corrective Action

Policy:
After implementing the corrective action(s), the laboratory monitors the results to ensure that the actions taken have been effective in overcoming the problems originally identified.

Details:
Monitoring is assigned to an appropriate individual such as the originator of the CAR or the originator's manager. Changes resulting from corrective action are documented.

4.11.5 Additional Audits

Policy:
Where the identification of nonconformities or departures casts doubts on compliance of policies, procedures, regulations, international quality standards, the appropriate areas of activity are promptly audited in accordance with section 4.14.

Details:
Special audits follow the implementation of corrective actions to confirm their effectiveness. A special audit is only necessary when a serious issue or risk to the business is identified. Special audits are carried out by trained and qualified personnel who are [whenever resources permit] independent of the activity to be audited. See section 4.14 for more details.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.12 Preventive Action

4.12.1 Preventive Action Identification

Policy:
Opportunities for needed improvement and potential sources of nonconformities, either technical or with the quality management system shall be identified. If action is required, action plans are developed, implemented and monitored, to reduce the likelihood of occurrence of such nonconformities and to take advantage of the improvement opportunities.

Details:

Records of preventive action include the following information:

- details of potential nonconformities
- investigation
- preventive action
- follow-up verification

These records are maintained in the Preventive Action Request (PAR) form/binder.

4.12.2 Preventive Action Plans

Policy:
The preventive action procedure includes the initiation of such actions and application of controls to ensure that they are effective.

Details:
Preventive action may result from the review of operational procedures and analysis of data. Analysis of data includes trend analysis, analysis of proficiency testing results, and risk analysis.

The SOP ADMINPREVACTION043010 is utilized to implement opportunities for needed improvement and prevent potential sources of nonconformities.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.13 Control of Records

The York Quality Assurance Program has been developed to provide analytical results of known quality. To demonstrate that quality has been achieved, York maintains a record management system that includes documents pertinent to the analytical performance of the laboratory. Laboratory records are maintained in two broad categories.

- Documents which are specific to a project or a group of samples within an ongoing project, such as chain-of-custody, and raw analytical data.
- Documents which demonstrate overall laboratory operation, such as instrument log books and control charts. These records will directly affect the data for a specific project, but in general their applicability is not limited to one project.

This procedure addresses identification, collection, indexing, access, file, store, maintain, protect, backup, and disposal of quality and technical records. To outline procedures for the protection and backup of data/records held on computers.

4.13.1 General

This procedure applies to all quality and technical records. Quality records include audit reports, management review, corrective action requests, and preventive action requests. Technical records include observations, calculations, derived data, calibration records, personnel records, and test reports.

4.13.1.1 Procedures

Policy:
The SOP ADMINRECORDS043010 is used to identify, collect, index, access, file, store, maintain, protect, backup, and dispose quality and technical records. Quality records include reports from internal audits and management reviews as well as corrective and preventive action records.

Details:
Records are available to demonstrate conformance to requirements and effective operation of the Quality Management System. Quality records from suppliers are also controlled.

All records, (electronic and hard copy) including test reports, are safely stored and held secure in locked areas, and in confidence to the Client. Records are maintained in the designated archival area for **five (5)** years with the exception of potable water conducted from NY which is 10 years.

4.13.1.2 PROJECT RECORDS

Separate files are maintained for each project. Filing of records for a specific project shall be by the unique project identification number assigned by the laboratory for that project. Within a project file, categories of information are filed separately. Upon completion of all projects (SDGs), the file contents are scanned to an unalterable image file (.pdf) and archived removable hard disk media. Such media are held for a period of 5 years. Paper copy is maintained for 30 days after data submission. Following is a brief discussion of each item that is maintained for each project file.

A - Correspondence

All correspondence pertinent to the analytical program shall be maintained. This includes letters to and from clients and internal memorandums. Correspondence should be filed chronologically.

B - Chain-of-Custody

Chain-of-custody records shall be maintained by the laboratory. The chain-of-custody forms should be filed for samples as received and should be placed in the project file immediately after they are signed by Sample Control personnel.

C - Request for Analysis

Analysis requests provided by the field personnel are maintained in this file. Also, any changes or additions to the analytical program should be documented in this file.

D - Calibration Records

In general, calibration records are maintained with laboratory operation records. However, if an analytical program requires a calibration which is performed solely for a project, the records shall be maintained in this file. If calibration is performed as an integral part of the analytical process, the calibration records should be maintained with the analytical data. If these items are in the Element LIMS system, this is not required.

E - Analytical Data

Analytical data files should be complete for a group of samples. The file should contain raw analytical data, processing of the data and/or data reduction, and any data validation. It should be possible to use data files to completely demonstrate that the data have been adequately obtained, processed, and reviewed.

G - Quality Control Samples

If quality control samples, such as field blanks, are processed for a specific project, the data shall be maintained with the project file. The results of quality control samples processed on a general basis are included in the laboratory operations files. Statistical evaluation of quality control sample data for a project shall also be maintained in this file.

If quality control samples are processed as an integral part of a group of samples such that the data cannot be readily separated, the quality control sample data can be stored with the analytical data.

H - Data Reports

Complete copies of all reports issued by the laboratory are accessible on the Network and are not stored with the project files.

I - Project-Specific Requirements

If a project requires analytical procedures other than what is adopted in the York Quality Assurance Program, the requirements shall be included in this file. Specific requirements may be due to government regulations, specific contracts, or project need. Changes from stated practice can be, for example, frequency of QC sample analysis, test method, statistical data evaluation, and reporting format.

If it is necessary to adopt a new analytical procedure, a procedure different than conventionally used, or alter an existing procedure, the method used for the project must be documented. If the analytical procedure is developed by York as part of the analytical program, the procedure shall be documented and included. If an existing procedure is altered, the Analyst or Group Leader shall prepare a memorandum to the project file stating what the changes were and the justification for change.

J - Nonconformance

Nonconformance's and subsequent corrective actions which are specific to a project are included in this file. The record should be in the form of a memorandum (or copy of other records discussed in this manual) with the nonconformance stated, how it was corrected, and the approval for the correction. A separate file for each incidence is not required, the file should be maintained chronologically.

K - QA Plan

If a specific Quality Assurance Project Plan, and revisions, are prepared for a project, they shall be stored in this file.

L - Miscellaneous

The miscellaneous file includes all records not applicable to the previous categories.

4.13.1.3 GENERAL LABORATORY OPERATIONS RECORDS

General laboratory records document overall laboratory performance and operations. These records are filed separately from project records and will be maintained so they can be referenced to project records if necessary. Examples of general records pertinent to project records are instrument log books and computer software verifications.

There are two types of general laboratory records:

< Documents which demonstrate laboratory performance

< Reference documents for laboratory operations

Records which demonstrate laboratory performance shall be filed in categories in a manner similar to project files. Reference documents are not indexed and their usage is not controlled.

Many of the laboratory operations records are in daily use, such as the Master Log Book, instrument calibration logs, and control charts. It is not intended that the records be stored daily while they are in use. However, when individual log books, etc. are filled, they shall be placed in the files.

Following is a brief discussion of the General Lab Operations records:

A - Sample Log Books

The Sample Log Books chronologically record all samples entering the laboratory, independent of project designation.

B - Instrument Calibration Logs

All calibration performed independent of a specific project shall be recorded by instrument. A separate file should be maintained for each instrument subject to calibration. These files are scanned and archived on the network by instrument and date.

C - Instrument Maintenance Logs

Separate maintenance files should be kept for each instrument incorporated in the preventive maintenance program. The file shall include records of maintenance performed in-house or by outside groups.

D - Performance Evaluation Records

Laboratory participation in Performance Evaluation Programs shall be documented in this category. If performance standards are analyzed as part of the overall quality control sample program, the results should be included in Category G.

E - Certification Program (NY, CT, NJ , PA) Records

If the laboratory participates in certification programs, such as the NELAP, ELAP, etc. program, the results shall be maintained in this category. Records should include all correspondence, analytical data, agency results, etc.

F - Control Charts

Control charts are generated and maintained on the Element LIMS.

G- Purchased Material Certificates

All information which verifies that purchased materials meet the requirements of the laboratory should be maintained. Certification may be supplied by a vendor or from in-house verification analysis. Separate files should be kept for chemicals, gases, water, glassware, etc.
These certificates are scanned and entered into LIMS.

4.13.1.4 RECORD CONTROL

The individual responsible for the records management system is the QA Officer. For hard copy records , this person shall:

- Initiate new files
- Add new records to existing files, initiate new files within a category, and update any index
- Assist laboratory personnel in withdrawing and returning records.

To maintain control of hard copy records within the laboratory, a Records Accession LOG is maintained. The LOG indicates:

- Project from which file is borrowed
- Date and person borrowing record
- Date returned to the record system

The dating format for records is MM/DD/YYYY.

4.13.2.1 Record Integrity

Policy:
All records are to be legible and shall be retained in such a way that they are readily retrievable in facilities that provide a suitable environment to prevent damage or deterioration and to prevent loss.

Details:
The retention time for hard copy and electronic records is set at **five** years. For the State of NY potable water, the time is extended to 10 years.

Records may be in the form of any type of media, such as hard copy or electronic media.

4.13.2.2 Record Security

Policy:
All records are held secure and in confidence.

Details:
Access to records is secured through limited access areas and computer access via user defined privileges.

4.13.2.3 Records Backup

Policy:
The SOP ADMINRECORDS043010 is followed to protect and backup data/records held on computers at all times and to prevent unauthorized access to or amendment of data/records on computers.
Details:
Data are password protected.

Backups ensure integrity and availability of data / information in the event of a system / power failure. Backup is done to a DATTO system and simultaneously to a Cloud backup solution maintained by our outside IT consultants.

4.13.3 Technical Records

4.13.3.1 Record Information

Policy:
Original observations, calculations, derived data and sufficient information to establish an audit trail, calibration records, personnel records and a copy of each test report issued are retained for five years (ten years for NY State potable water data).

The records for each test shall contain sufficient information to facilitate, if possible, identification of factors affecting the test uncertainty and to enable the test or calibration to be repeated under conditions as close as possible to the original. The records include the identity of personnel responsible for sampling, performing of each test and/or calibration and checking of results.

Details:
Technical records are accumulations of data (see 5.4.7) and information that result from carrying out tests and/or calibrations and which indicate whether specified quality or process parameters are achieved. They may include forms, contracts, work sheets, work books, note books, instrument printouts, magnetic media, check sheets, work notes, control graphs, test reports, calibration certificates, Client’s notes, papers and feedback, and test reports to Clients.

The records for each test contain sufficient information to permit its reconstruction.
Records include:

- date of sampling
- sample receipt
- sample handling and storage

- identification of personnel
- analyst proficiency
- instrumentation identification and performance
- calibration records
- media performance, where appropriate
- test batch # or lot #, where appropriate
- results
- reports (mailed, e-mailed, faxed)
- review

Note – the above records may be stored in separate locations. They are cross-referenced for easy retrieval.

4.13.3.2 Recording

Policy:
Observations, data, and calculations are clearly and permanently recorded and identifiable to the specific job at the time they are made.

Details:
Handwritten records must be legible and made with indelible ink immediately after an observation, after data is collected and/or after calculations are made.

4.13.3.3 Corrections to Records

Policy:
Changes to test data are made so as not to obscure or delete the previous data entry.

Details:
Mistakes are crossed out and the correct value entered alongside. Mistakes are not erased, made illegible, or deleted. All alterations to records are signed or initialed by the person making the correction. In the case of computer-collected data, similar measures are taken to avoid loss or change of original data.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.14 Internal Audits

4.14.1 Internal Audit Program

Policy:
The internal audit program involves periodic audits conducted according to a predetermined schedule for each year. This program is defined on an annual basis and conducted as outlined in this section with further details found in SOP ADMININTAUDIT043010. All elements of this Quality Manual will be audited each year and all relevant laboratory records are available to personnel conducting the audit. These audits are performed to verify operations continue to comply with the requirements of this Quality Manual and are effective.

Details:
The Quality Manual, test procedures, and laboratory results are verified for compliance. It is the responsibility of the Quality Assurance Officer to plan and organize audits as required by the schedule and requested by management. Audits are carried out by trained and qualified personnel who are independent of the activity to be audited. Personnel are not to audit their own activities except when it can be demonstrated that an effective audit will be carried out (see also 4.11.5). Audits are performed through the aid of a checklist prepared in advance to minimize the possibility of overlooking any details during the audit.

Generally, the types of audits include:
- quality management system
- processes and procedures (SOPs)
- services and reports

4.14.2 Corrective Action

Policy:
When audit findings cast doubt on the effectiveness of the operations or on the correctness or validity of test or calibration results, timely corrective action is taken and Clients are notified if investigations show that laboratory results may have been affected.

Details:
Nonconformities that can be resolved easily are to be corrected immediately, ideally during the audit. Records are made on the audit checklist. Nonconformities that require a

more involved resolution are recorded on a CAR and resolved as described in section 4.11.

Corrective actions and Client modifications must be kept on record for each audit deviation that casts doubt as described in this section.

4.14.3 Records and Management

Policy:
Records are made of the activity being audited, the audit findings, and corrective actions that arise. Management ensures that corrective actions are discharged within an appropriate and agreed timeline.

Details:
A report is prepared by the auditors and distributed to those audited and/or the area manager/supervisor within an appropriate and agreed timeline. The audit report may include the following sections, as appropriate:

- audit objective and scope
- area or section audited
- personnel involved – auditors and auditees
- date of audit
- reference documents
- observations including nonconformities and commendations
- opening and closing meetings
- recommendations/corrective actions
- audit report distribution and review

The appropriate manager is responsible for ensuring that corrective actions are sufficiently recorded. Follow-up is performed by the auditor and recorded when corrective action is complete and deemed effective. The audit records are kept on the network.

4.14.4 Follow-up Audits

Policy:
Follow-up audits are performed to verify and record the implementation and effectiveness of the corrective action taken.

Details:
The follow-up audit is performed at a mutually acceptable time between the area implementing corrective action and the auditor. This time is determined when the Corrective Action Report (CAR)is issued.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.15 Management Reviews

4.15.1 Review of Quality Management System and Testing

Policy:
Top management periodically (annually) and in accordance with a predetermined schedule and SOP ADMINMGMTREV043010, conduct a review of the laboratory's quality management system and testing activities to ensure their continuing suitability and effectiveness and to introduce any necessary changes or improvements.

Details:
The review takes account of:

- suitability of policies and procedures
- reports from managerial and supervisory personnel
- the outcome of recent internal audits
- corrective and preventive actions
- assessments by external bodies
- results of inter-laboratory comparisons or proficiency tests
- changes in the volume and type of work undertaken
- feedback from Clients, including complaints and Client satisfaction surveys
- recommendations for improvement
- other relevant factors, such as quality control activities, resources and personnel training

The minimum period for conducting a management review is once a year to be completed by the end of the 1st quarter of the ensuing year. Results of the review feed into the laboratory planning system and include goals, objectives and action plans for the coming year.

A management review can be supplemented by consideration of related subjects at regular management meetings.

4.15.2 Findings, Actions, and Records

Policy and Details:
Findings from management reviews and the actions that arise are recorded in the minutes of the meeting. Management will ensure that the actions are discharged within an appropriate and agreed upon timeline.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

4.16 Data Integrity Plan

4.16.1 Purpose

The purpose of the Data Integrity Plan is four-fold:

(a) to describe the laboratory's data integrity system,
(b) to emphasize the paramount importance of ethics in the performance of all analytical work,
(c) to obtain the commitment of laboratory staff to the principle that all analyses shall be performed in a controlled and documented manner, and
(d) to ensure that laboratory staff consistently meet the specific ethical requirements defined in this data integrity plan.

4.16.2 Scope

This procedure applies to all analyses and activities performed within the laboratory's scope of accreditation.

4.16.3 Responsibilities

Senior managers support and the Lab Director and QA Officer provide initial data integrity training and on-going annual training to all laboratory staff. Senior managers ensure that only staff who sign the ethics agreement are allowed to work in the laboratory.

The QA Officer maintains records of ethics/data integrity training and data integrity monitoring.

4.16.4 Procedure

Ethics Training

Ethics training is a required part of new employee orientation and is provided on an annual basis for all laboratory managers and staff by senior laboratory management. Initial training during orientation includes the overall organizational mission and its relationship to the absolute need for honesty and full disclosure in all analytical reporting and record-keeping. Resources where applicable ethics policy and law can be found are made available and copies are distributed. Examples are described that illustrate unethical behavior and ethical behavior related to laboratory data manipulation. Laboratory standard operating procedures are reviewed with respect to proper procedure, data qualifiers, and adequacy of record keeping. Management will disclose that reports and the data generated to support them are subject to routine in-depth review.

The organizations response to infractions of the data integrity plan will be discussed and the trainee shall understand that infractions will be investigated in a detailed way. The consequences to an employee found to be in violation of the data integrity plan may result in immediate termination, debarment, and/or civil/criminal prosecution. Confidentiality is assured during this process.

Employee attendance or participation is documented.

Ethics Agreement

Following initial ethics training and on-going annual training for laboratory managers and staff, trainees shall sign a written ethics agreement. Senior managers who provide the training shall also sign the agreement. The agreement states that the signers will not engage in any unethical practices with respect to data integrity nor will they tolerate improper behavior in others if it is observed or suspected. By signing, senior managers acknowledge their duties in upholding the spirit and intent of the data integrity system and in effectively implementing the specific requirements of the plan.

Monitoring

Data integrity monitoring is accomplished by periodic data package and manual integration reviews by the QA Officer (QAO) or designeee, annual internal audits, and monthly QC sample tracking. Therefore the QAO, shall have an in-depth understanding of typical inappropriate analytical behavior and be trained in the data integrity system. Refer to the laboratory's SOP for data review.

Documentation

All data integrity incidents must be documented, including investigative findings and disciplinary actions. Corrective actions are recorded. Confidentiality is critical and maintained by use of password protected files. If client disclosure is determined to be necessary by senior laboratory management, then such disclosures and outcomes are recorded.

All data integrity documents, plans, SOPs, personal records and records of investigations shall be maintained for a period of five years. Documents are subject to the document control system and records are subject to the records management system as described in the laboratory's quality manual and related SOPs.

4.16.5 References

Internal
York Data Integrity and Ethics Training SOP (ADMIN Ethics 040102)
York Internal Quality Audit SOP (ADMIN Audit 043010)
York Manual Integration Review SOP (ADMIN ManIntReview 043010)
and any updates to the above SOPs

External

NELAC Quality Systems, Chapter 5, Sections *5.4.2.3, 5.4.2.6, and 5.4.15*, June 5, 2003 and Module 2, *Sections 4.2.8.4, 4.2.8.1, 5.2.7, and 4.16*, August 24, 2009.

Revision History

Revision No.	Date	Responsible Person	Description of Change
1	12/26/12		Initial Release

4.16.6 Annual Review (The review is to be documented if the Quality Manual has not been revised in the past 12 months)

Signature

Ben Gulizia, Lab Director
Name/Title Date: January 19, 2019

Sarah Widomski
Signature

Sarah Widomski, Corporate QA Officer
Name/Title Date: January 19, 2019

5.1 Technical Requirements

5.2 General

5.2.1 .1 Correctness and Reliability

Policy and Details:
Correctness and reliability of the tests and/or calibrations performed have many contributing factors including:

- human factors (see section 5.2)
- accommodation and environmental conditions (see section 5.3)
- test and calibration methods and method validation (see section 5.4)
- instrumentation (see section 5.5)
- measurement traceability (see section 5.6)
- sampling (see section 5.7)
- handling of test and calibration items (see section 5.8)

5.2.2 Measurement Uncertainty

Policy:
When developing test and calibration methods and procedures, total measurement uncertainty must be accounted for in the training and qualification of personnel, and in the selection and calibration of instrumentation.

Details:
The extent to which the factors contribute to total measurement uncertainty differs between (types of) tests and between (types of) calibrations.

See section 5.4.6 for more details.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.2 Personnel

York recognizes that all laboratory personnel affect data quality. This manual has been prepared so that staff members will be cognizant of the procedures adopted by York for the production of analytical data, and so they will be aware of their responsibilities.

Staff are properly trained and qualified for their positions and specific procedures.

5.2.1 Competence and Qualification

Policy:
Management ensures the competency of all personnel charged with analysis and those evaluating results and signing test reports. Appropriate supervision is provided for employees undergoing training. Personnel performing specific tasks are qualified on the basis of appropriate education, training, experience and/or demonstrated skills, as required.

In addition, personnel responsible for the opinions and interpretations included in test reports also have:

- relevant knowledge of the technology used for the analysis, materials
- knowledge of the general requirements expressed in the legislation and standards
- an understanding of the significance of deviations found with regard to the normal use of the data

Details:
Management defines the minimum levels of qualification and experience necessary for all posts within the laboratory. In some technical areas it may be required that the personnel performing certain tasks be certified. The laboratory is responsible for fulfilling specified certification requirements of personnel. The requirements for personnel certification might be regulatory, might be included in the standards for the specific technical field, or required by the client.

Continued competence is monitored and where this is not achieved, the need to retrain personnel is considered. Where a method or technique is not in regular use, verification of personnel performance prior to testing may be necessary.

5.2.2 Training Policies and Procedures

Policy:
Management will formulate the goals with respect to the education and the skills of the laboratory personnel. The training program is relevant to the present and anticipated tasks

of the laboratory. SOP# ADMIN Training Revision No. 1.4 09/04/2014 is utilized to identify training needs and providing the necessary training for personnel. The effectiveness of the training actions taken is evaluated.

Details:
The skills and knowledge are defined in the job description for each job function as described in section 5.2.4. Management compares the job description to the skills and knowledge of the new incumbent to determine the training needs.

Training in the laboratory must include all methods or parts of methods and techniques that personnel are asked to perform. Minimally, the analyst must demonstrate competency (Initial Demonstration of Capability) through observation by management and verification using replicate and/or check samples. For technicians who perform only parts of the method, confirmation of competency may be verified by observation only. Re-verification of all personnel must be performed annually on all methods or techniques pertinent to their job description.

In some cases it may be appropriate to define competence related to a particular technique or instrument rather then methods. If so, it will be necessary to define for each method, the necessary technique-based competence required together with any additional requirements.

5.2.3 Employees

Policy:
Competent permanent or part-time employees are employed in the laboratory. No contract labor is used. The Laboratory Director ensures that all technical employees, and key support personnel are supervised and work in accordance to the policies and procedures of this Quality Manual.

Details:
Testing must be either performed or supervised by an experienced person qualified to perform the test. Personnel have relevant practical work experience and training before being allowed to perform accredited work.

5.2.4 Job Descriptions

Policy:
Current job descriptions for managerial, technical and key support personnel involved in laboratory analyses are maintained centrally on the Network with appropriate access.

Details:
Minimum contents of job descriptions include:
- the duty of performing preparation/analysis
- the act of planning analyses and evaluation of results
- the responsibility of developing and validating new methods as / when requested
- expertise and experience
- qualifications and training programs
- managerial duties if applicable

Job descriptions are dated and signed to demonstrate that each incumbent has read it and is in agreement. They are maintained current on the Network.

5.2.5 Authorized Personnel

Policy:
Management authorizes specific personnel to perform particular types of analysis, to issue test reports, to give opinions and interpretations and to operate particular types of instrumentation. Records of the relevant competence, educational and professional qualifications, training, skills and experience of all technical personnel and contracted personnel are maintained. This information is readily available and includes the date on which authorization and/or competence was confirmed and the criteria on which the authorization is based and the confirming authority.

Details:
The purpose of these records is to provide evidence that personnel have been adequately trained and their competence to perform particular tests has been assessed. In some cases it may be pertinent to state any particular limitations to competence. The records are maintained in a registry of skills and include:
- academic and professional qualifications
- external and internal courses attended
- relevant on-the-job training and retraining as necessary (i.e., demonstration of capability)
- skills and experience (i.e., resume-maintained in employee administration file)
- relevant authorizations

Records are held centrally in the Employee Training Records.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.3 Accommodation and Environmental Conditions

5.3.1 Facility

Policy:
Laboratory facilities are appropriate to attain correct performance of all analyses. This may include, but not limited to, energy sources, lighting, heating, ventilation and any other environmental conditions.

Appropriate care is taken to ensure that the environment does not invalidate the results or adversely affect the required quality of any measurement. The technical requirements for accommodation and environmental conditions that can affect the results of tests and calibrations are documented.

Details:
This section deals with the test areas in the laboratory and premises for support such as sample receipt and storage. Central laboratory supplies and services, such as water purification systems, air supply, vacuum source, and sample storage, are appropriate to facilitate proper performance of analyses.

5.3.2 Monitoring

Policy:
Critical environmental conditions are monitored, controlled and recorded as required by the relevant specifications, methods, and procedures or where they may influence the quality of the results. Due attention is paid, for example, to the potential for cross contamination by methylene chloride, acetone and hexanes which are used in the Extractions processes, as appropriate to the technical activities concerned. Analyses are stopped when the environmental conditions jeopardize the results.

Details:
Laboratories are ventilated to reduce the levels of contamination, lower humidity, and control temperature. Laboratories' test areas are air-conditioned. The relative humidity in test areas is 45-70 and the temperature is 20-25 °C. Volatiles analyses are conducted in a separate laboratory where the air conditioning system produces a positive pressure in the laboratory and the air intake (economizer) is disabled. In addition, samples for volatiles are stored in a separate Sample Control room in their own refrigerators to minimize potential for cross contamination.

Bench tops and floors are made of impervious, smooth easily cleaned materials. There is at least two linear meters workspace per analyst while working. Walls and ceilings are made of materials that are smooth and easily cleaned.

5.3.3 Separation of Incompatible Activities

Policy:
Effective separation between neighboring areas is made when the activities are incompatible. Measures are taken to prevent cross-contamination.

Details:
Reference materials and certified reference materials must be kept separated from samples (log-in and storage). Sample log-in and storage must are segregated, in separate areas from the testing laboratory, and include proper sanitation to exclude the possibility of cross-contamination. Segregation of activities is achieved through time and space allocations.

An example of space segregation would be for a trace volatiles analysis. Physical separation of the trace volatiles analysis from Extractions using solvents is achieved through the use of separate rooms. This also applies to samples for VOA analysis.

An example of time segregation would be the coordination of activities at different times. It may be appropriate to perform work on “cleaner” samples first before starting “dirtier” type samples.

5.3.4 Controlled Access

Policy:
Access to and use of areas affecting quality of the analyses is defined and controlled.

Details:
Access to the laboratory is restricted to authorized personnel. The authorized personnel are made aware of the following items:

- the intended use of the area
- the restrictions imposed on working within such areas
- the reasons for imposing the restrictions

5.3.5 Good Housekeeping

Policy:
Measures are taken to ensure good housekeeping in the laboratory. Special procedures are prepared when necessary.

Details:
Controlled use of cleaning and pest control materials is exercised. The laboratory complies with the local health and safety requirements.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.4 Tests and Calibration Methods and Method Validation

5.4.1 General

Policy:
Methods and procedures used for all analyses are appropriate as per:
- courier handling, transport, storage, and preparation of items to be tested
- an estimation of the measurement of uncertainty as well as statistical techniques for analysis of test data where appropriate

Instructions on the use and operation of all relevant instrumentation and on the handling and preparation of items for testing are available. All instructions, standards, manuals and reference data relevant to the work of the laboratory are maintained current and readily available to personnel. Deviation from SOP and test methods must be documented, technically justified, authorized, and accepted by the client.

Details:
There are SOPs for sample handling, transport, storage, preparation, QA/QC procedures, and standards for approving / rejecting results. These may be combined with or separate from the method. The content of a test method or SOP generally includes:
- scope, applicability, definitions
- description of test items
- holding times
- quantities to be tested
- materials and instrumentation required
- physical environmental conditions required (temperatures, pH requirements)
- description of procedures

- sample identification
- method of recording observations and results
- safety measures
- waste management/pollution prevention
- documentation
- method for data analysis and presentation
- sensitivity of method
- quality control plan
- Revision history

National or state standards or other recognized specifications that contain sufficient and concise information on how to perform the analyses are not necessarily supplemented or rewritten as an internal procedure when they are written in a way that can be used as published by laboratory staff. Consideration may need to be given to providing additional documentation for optional steps in the method.

5.4.2 Selection of Methods

Policy:
Preparation and analysis methods meet the needs of the client and are appropriate for the analysis undertaken. Preference is given to reference methods published as international, Federal, or State standards. The laboratory ensures that the latest edition of a standard is used unless it is not appropriate or possible to do so. When necessary, the standard is supplemented with additional details to ensure consistent application.

Details:
Methods that have been published either in international, Federal, or State standards, or by reputable technical organizations, or in relevant scientific texts or journals, or as specified by the manufacturer are selected when the client does not specify the method to be used. These methods may be adopted from the Environmental Protection Agency, ASTM, Standard Methods for the Examination of Water and Wastewater, Various State agencies, etc.
The ability of the laboratory to achieve satisfactory performance against documented performance characteristics is verified before samples are analyzed.

Laboratory-developed methods or methods adopted by the laboratory may also be used if they are appropriate for the intended use and if they are validated. The client is informed as to the method chosen. The laboratory confirms that it can properly operate standardized methods before introducing the samples for analysis.

The client is informed when the method proposed by the client is considered to be inappropriate or out of date.

5.4.3 Laboratory-Developed Methods

Policy:
Introduction of test methods developed internally is a planned activity and is assigned to qualified personnel equipped with adequate resources. Plans are updated as development proceeds and ensure effective communication among all personnel involved.

Details:
Methods developed in-house are validated and authorized before use. Where available, Certified Reference Materials (CRMs) are used to determine any systemic bias, or where possible results are compared with other techniques, preferably based on different principles of analysis. Determination of uncertainty must be part of this validation process and is essential for ongoing quality control.

5.4.4 Non-Standard Methods

Policy:
Utilization of non-standard methods is subject to agreement with the client and includes a clear specification of the client's requirements and the purpose of the test. The developed method is validated appropriately before use.

Details:
Discussion and agreement for the use of non-standard methods is recorded as part of contract review procedures (see section 4.4).

All non-standard and new tests are validated for their intended purpose. Qualitative test methods must be validated to demonstrate estimated sensitivity and specificity, relative accuracy to official methods (if appropriate), positive and negative deviation, limit of detection, matrix effect, repeatability, and reproducibility.

Quantitative test methods are validated to demonstrate specificity, sensitivity, relative accuracy, positive and negative deviation, repeatability, reproducibility, and limit of determination.

For new methods where procedures are developing rapidly, especially for emergency situations, it may be necessary to circumvent normal validation procedures. Minimally, this must be a demonstrated recovery in replicate.

New test and/or calibration methods are documented prior to providing test and/or calibration results to clients and contain at least the following information:

- appropriate identification
- scope
- description of the type of item to be tested or calibrated
- parameters or quantities to be determined
- apparatus and instrumentation, including technical performance requirements
- reference standards and reference materials required
- environmental conditions required and any stabilization period needed
- description of the procedure, including:
  - affixing identification marks, handling, transporting, storing and preparing of items
  - ensuring checks are made before the work is started
  - checking that the instrumentation is working properly and, where required, calibrating and adjusting the instrumentation before each use
  - listing method of recording the observations and results
  - indicating any safety measures to be observed
- criteria and/or requirements for approval/rejection (quality control plan)
- data to be recorded and method of analysis and presentation
- uncertainty or procedure for estimating uncertainty

5.4.5 Validation of Methods

5.4.5.1 Performance Characteristics

Policy:

Validation of a method establishes, by systematic laboratory studies, that the performance characteristics of the method meet the specifications related to the intended use of the test results.

Details:

The performance characteristics of a validation plan includes, as applicable:

- selectivity and specificity
- range
- linearity
- sensitivity
- limit of detection
- limit of quantitation
- ruggedness
- accuracy
- precision
- reporting limit
- repeatability
- reproducibility
- recovery

- confirmation techniques
- criteria for the number of samples tested to validate method as per defined scope of method
- action levels where defined by regulation
- quality control incorporating statistics as applicable
- interpretation of population results as applicable

Performance characteristics that are selected take into account the intended use of the method, whether for screening, confirmatory analysis, or quantitation.
The design, verification of the method and documentation procedures for validation are planned and conducted by qualified personnel, equipped with adequate resources.

This section lists a few acceptable validation procedures. The choice of the procedure depends on the extent of the deviation from the published method.
Validation of methodology is a value judgment in which the performance parameters of the method are compared with the requirements for the test data. A prerequisite for a valid method is that data produced by the method must attain a state of statistical control.
Such a state is obtained when the mean value of a large number of individual values tends to approach a limiting value called the limiting mean.

Methods may be validated by one or more alternative procedures. Some of these procedures are described below. Apparent differences can be analyzed statistically to confirm their significance. In all cases, the reasons for choosing one or more alternatives must be documented.

- analysis of standard reference materials (SRM) that are identical or almost identical to the test samples
- in the absence of suitable SRMs, analysis of reference materials that are similar in all respect to the test samples; the use and validity of this reference material must be documented
- using an alternative method to measure the same parameter provides a very high level of confidence if results are confirmed
- recovery studies by the addition of a known concentration of the parameter of interest to some of the replicates being measured

The parameters to be determined include:

- the scope of the method and any known interference
- detection limit
- the range of concentration where the method is valid
- precision and bias
- intra-laboratory variations
- inter-laboratory variations

Judgment is required to determine if some or all of the above are required. Requirements will depend largely on the extent of deviation from the original method.

Developments in methodology and techniques require methods to be changed from time to time. The difference in performance between revised and obsolete methods is established so that it is possible to compare old and new data.

Where a change in method involves only minor adjustments, such as sample size, or different reagents, the amended method is validated and the changes brought to the attention of the accreditation body at the next accreditation audit. Where the proposed change involves technology or methodology, the laboratory seeks the approval of the accreditation body.

Records are kept on all validation activities. The records include any of the performance characteristics chosen, reference procedures or guidance documents followed to validate the method or custom validation procedure, and a final confirmation (memo to file) that the method validation results are acceptable for continued use of the method. An example statement would be “This memo serves as record that the validation of the XYZ Test Method has been approved for use by [name and title of approver]”.

5.4.5.2 for Use

Policy:
The laboratory validates non-standardized methods, laboratory-designed/developed methods, standardized methods used outside their intended range, and amplifications of standard methods to confirm that the methods are fit for the intended use. The validation is as extensive as is necessary to meet the needs in the given application or field of application (may include procedures for sampling, handling, and transportation). The laboratory records the results obtained, the procedure used for the validation, and a statement as to whether the method is fit for the intended use.

Details and Procedure:
Validation records are kept as in section 5.4.5.1. Included in these records is the validation procedure. The procedure used for the validation is likely to vary between different methods. Therefore, the procedures included in the laboratory records are not as detailed as a typical SOP, but are sufficient enough to re-create how the method was validated.

The techniques used for the determination of the performance of a method, are one of, or a combination of, the following:

- calibration using reference standards or reference materials

- comparison of results achieved with other methods
- inter-laboratory comparisons
- systematic assessment of the factors influencing the result
- assessment of the uncertainty of the results based on scientific understanding of the theoretical principles of the method and practical experience

When changes are made in the validated non-standard method, the influence of such changes carried out is documented and if appropriate a new validation is performed.

5.4.5.3 Client's Needs

Policy:
The range and accuracy of the values obtainable from validated methods (e.g., the uncertainty of the results, detection limit, selectivity of the method, linearity, limit of repeatability and/or reproducibility, robustness against external influences and/or cross-sensitivity against interference from the matrix of the sample/test object) as assessed for the intended use is relevant to the client's needs.

Details:
Validation includes the specification of the requirements, determination of the characteristics of the methods, the comparison of the requirements with the values of the characteristics of the method, and a statement on the validity.

As method development proceeds, regular review is required to verify that the needs of the client are still being fulfilled. Changing requirements requiring modifications to the development plan are approved and authorized.

Validation is always a balance between costs, risks, and technical possibilities.

5.4.6 Uncertainty of Measurement

5.4.6.1 Calibration

Policy:
Physical and chemical standards and instrumentation are calibrated or characterized internally and by subcontractors where appropriate.

Details and Procedures:
Repeatability and reproducibility data are components of measurement uncertainty and are determined as a first step towards producing estimates of this parameter. The uncertainty of measurement is available on the certificate of analysis or calibration certificate from a subcontractor.
Note – in-house calibrations include procedures for uncertainty of measurement estimates where this is common practice.

5.4.6.1.1 CALIBRATION PRACTICES

Instruments and instrumentation used at York are controlled by a formal calibration program. The program verifies that instrumentation is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and instrumentation which measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration may be performed by York personnel using reference standards, or externally by calibration agencies or instrumentation manufacturers.

This section of the Quality Manual prescribes the practices used by York to implement a calibration program. Specifics are not provided herein because the requirements for the calibration of instruments and instrumentation are dependent upon the type and expected performance of individual instruments and instrumentation. Such details are provided in the specific SOPs. Implementation is the responsibility of the Group Leaders and Analysts. The Quality Assurance Officer shall review the implementation of the program as discussed in previously.

Two types of calibration are discussed in this section:

- Operational calibration which is routinely performed as part of instrument usage, such as the development of initial calibration curves for GC, GC/MS, etc. Operational calibration is generally performed for instrument systems.

- Periodic calibration which is performed at prescribed intervals for instrumentation, such as balances and critical temperature measurement devices.

5.4.6.1.2 CALIBRATION SYSTEM

The following is a discussion of the elements comprising the calibration system.

5.4.6.1.3 Calibration Procedures

Written procedures are developed by York within the requirements of this manual for all instruments and instrumentation subject to calibration. Whenever possible, recognized procedures, such as those published by ASTM or the USEPA, or procedures provided by manufacturers are adopted. If established procedures are not available, a procedure shall be developed considering the type of instrumentation, stability characteristics of the instrumentation, required accuracy, and the effect of operational error on the quantities measured. As a minimum, the procedures shall include:

- Instrumentation to be calibrated
- Reference standards used for calibration
- Calibration technique and sequential actions
- Acceptable performance ranges
- Frequency of calibration
- Calibration documentation format

5.4.6.1.4 Instrumentation Identification

Instrumentation that is subject to calibration shall be uniquely identified so that calibration records can be designated with a specific instrument. Instrumentation identification can be by manufacturer's serial number, York inventory control number, or a unique number assigned by York.

5.4.6.1.5 Calibration Frequency

Instruments and instrumentation shall be calibrated at prescribed intervals and/or as part of the operational use of the instrumentation. Frequency shall be based on the type of instrumentation, inherent stability, manufacturer's recommendations, values provided in recognized standards, intended use, effect of error upon the measurement process, and prior experience.

5.4.6.1.6 Calibration Reference Standards

Two types of reference standards are used within the York laboratory for calibration:

- Physical standards, such as weights for calibrating balances and certified thermometers for calibrating working thermometers and ovens, which are generally used for periodic calibration.

- Chemical standards such as Standard Reference Materials (SRMs) provided by the National Bureau of Standards NIST or NIST-traceable standards which are primarily used for operational calibration.

Whenever possible, physical reference standards shall have known relationships to nationally recognized standards (e.g., NIST) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference standards shall be documented.
Whenever possible, chemical references standards shall be directly traceable to NIST SRMs and/or EPA. If SRMs are not available, compounds of certified high purity will be used to prepare calibration standards.

5.4.6.1.7 Calibration Failure

Instrumentation that fails calibration or becomes inoperable during use shall be removed from service and segregated to prevent inadvertent use, or shall be tagged to indicate it is out of service. Such instrumentation shall be repaired and satisfactorily recalibrated before reuse

Scheduled calibration of instrumentation does not relieve the laboratory staff of the responsibility for using properly functioning instrumentation. If an instrumentation malfunction is suspected, the instrumentation shall be tagged and removed from service and recalibrated. If it fails recalibration, the above process shall apply.

5.4.6.1.8 Calibration Records

Records shall be prepared and maintained for each piece of instrumentation subject to calibration. Records demonstrating accuracy of reference standards shall also be maintained.

Records for periodically calibrated instrumentation shall include, as appropriate:

- Identification number of instrumentation and type of instrumentation.

- Calibration frequency and acceptable tolerances.

- Identification of calibration procedure used.

- Date calibration was performed.
- Identity of York personnel and/or external agencies performing the calibration.
- Reference standards used for calibration.
- Calibration date.
- Certificates or statements of calibration provided by manufacturers and external agencies, and traceability to national standards.
- Information regarding calibration acceptance or failure and any repair of failed instrumentation.

Records for periodically calibrated instrumentation shall be maintained in the Quality Assurance Folder Records. Records for each instrument/instrumentation and physical reference standard shall be kept in a separate folder. The title sheet for each file shall be a summary of calibrations performed. It is recommended that an index precede the instrumentation files which lists in matrix form all instrumentation and physical standards, calibration frequency, and dates for upcoming calibration. The use of a calibration due date matrix provides ready reference so that calibration can be maintained by the Group Leaders.

For instruments and instrumentation that are calibrated on an operational basis, calibration generally consists of determining instrumental response against compounds of known composition and concentration or the preparation of a standard response curve (either linear or average response factor) of the same compound at different concentrations. Records of these calibrations are be maintained in several ways:

- The calibration data for all GC, GC/MS, ICP/ICPMS, Ion Chromatography is kept in a uniquely numbered QUALITY BATCH (QB) file. These files include all initial calibrations and continuing calibrations, as well as method blanks, spikes, duplicates and control (LCS) data. The nomenclature for these files follows this example:
    - For a volatiles run on April 1, 2016 on Volatiles GC/MS # 1, the batch QA/QC data is placed in a QB file identified as QBV1040116A. The A represents the first batch of the day. If two batches are run, a B is affixed, etc.

- This unique QB number appears on all sample headers to allow for cross referencing all QA data for a particular batch to each sample.

➢ A log book for each parameter documents all calibration and QA data for each wet chemistry, gravimetric or spectrophotometric analysis.

For operational calibration, the following is recommended:

As above, calibration data must be included in a batch file system. If samples from different projects are processed together, calibration data is included in a batch folder.

- The specific SOPs detail:
- Calibration instructions (curve preparation, linear ranges, etc.).
- Procedures for chemical standards preparations.

5.4.6.1.9 OPERATIONAL CALIBRATION

Operational calibration is generally performed as part of the analytical procedure. Included may be the analysis of a method blank and the preparation of continuing calibration verification standard or curve. Operational calibration is dependent upon the instrumentation within York, and as previously discussed, the laboratory uses a specific SOP for this purpose.

Following is a brief discussion of the analysis of method blanks and preparation of calibration curves. Guidelines for the major instrument systems within the York laboratory follow:

5.4.6.1.10 General Calibration Procedures

The initial phase of a laboratory testing program requires the selection and certification of the method best suited for an individual parameter. Certification, or verification, is the elimination, or minimizing, of determinate errors which may be due to Analyst's error, the use of less-than-optimum instrumentation, reagents, solvents, or gases. The quality of materials, even though they are AR grade or better, may vary from one source to another. The Analyst must determine, through the use of reagent and/or solvent blanks, if materials are free from interfering substances which could affect the analysis. Other steps in certifying the method include the determination of a method blank and the preparation of a standard calibration curve.

5.4.6.1.11 Method Blank

After determining the individual reagent or solvent blanks, the Analyst defines the method blank to determine if the cumulative blank interferes with the analysis. The method blank is defined by following the procedures step by step, including the addition of all of the reagents and solvents, in the quantity required by the method. If the cumulative blank interferes with the determination, steps must be taken to eliminate or reduce the interference to a level that will permit the combination of solvents and reagents to be used. If the blank interference cannot be eliminated, the magnitude of the interference must be considered when calculating the concentration of specific constituents in the samples analyzed.

A method blank must be determined whenever an analysis is made. The number of blanks is determined by the method of analysis and the number of samples analyzed at a given time, but is typically one per 20 samples or one per batch whichever is less.

5.4.6.1.12 Preparation of Standard Calibration Curve

Concurrent with the preparation of reagent and method blanks, a standard calibration curve is accomplished by using calibration standards. The process is summarized as:

- Preparation of a standard calibration curve is accomplished by using five calibration standards prepared by mixing the species to be analyzed into the "solvent" that is to be introduced into the instrument.

- The concentration of the calibration standards are chosen to cover the working range of the instrument.

- All sample measurements are made within this working range.

- The calibration curve is prepared by plotting instrument response versus concentration of the species analyzed. Acceptable regression (linear or Quadratic) or RSDs are defined in the analysis specific SOPs.

- Concentrations of the sample prepared with the same procedure are read directly from the calibration curve or average response factor as detailed in the SOPs.

5.4.6.1.13 GC/MS and LC/MS/MS CALIBRATION PROCEDURES

This section outlines the minimum operations necessary to satisfy analytical requirements associated with the determination of various target lists of organics compounds in air, water and soil/sediment samples. The following operations must be performed routinely (as specified in the SOPs) in the laboratory:

- Documentation of GC/MS or LC-MS/MS mass calibration and abundance pattern.
- Documentation of MS response factor stability.
- Internal standard response and retention time monitoring.

6.2.2.1 Tuning and GC/MS Mass Calibration

Prior to initiating data collection, it is necessary to establish that a given GC/MS meets the standard mass spectral abundance criteria. This is accomplished through the analysis of decafluorotriphenylphosphine (DFTPP) for base/neutral and acid (BNA) compounds or p-bromofluorobenzene (BFB) for volatile compounds. The ion abundance criteria as listed in the methods or SOPs for each calibration compound should be met before samples, blanks, or standards can be analyzed.

DFTPP (decafluorotriphenylphosphine)

Each GC/MS system used for the analysis of semivolatile compounds must be tuned to meet the abundance criteria of the method for a 50 nanogram (ng) injection of DFTPP. DFTPP may be analyzed separately or as part of the calibration standard, and the criteria must be demonstrated each (12) hours of use. Documentation of the calibration must be provided in the form of a bar graph plot and as a mass listing.

BFB (p-bromofluorobenzene)

Each GC/MS system used for the analysis of volatile compounds must be tuned to meet the proper abundance criteria for a 50 ng injection of BFB. The criteria should be demonstrated each (12) hours of use. Documentation of the calibration should be provided in the form of a bar graph plot and as a mass listing.

Analysts obtain a system generated GC/MS Tuning and Mass Calibration each time an analytical system is tuned.

5.4.6.1.14 Calibration of the GC/MS System

Prior to the analysis of samples and after tuning criteria have been met, the GC/MS system must be initially calibrated at a minimum of five concentrations to determine the linearity of response utilizing standards. For GC/MS analysis, typical linear ranges are 0.05 (SIM) to 200 ng for base neutrals, 5 to 400 ng for certain phenols, and 0.1 to 1,000 ng for volatiles.

Calibration standards are prepared to cover the linear range and are detailed in the SOPs.

Semivolatiles (B/N/A)

Initial calibration of semivolatile compounds is recommended at 5 to 140 ng for SCAN analysis with SIM covering the range 0.05 to 2 ng.

Pesticides & PCB

Pesticides by GC/ECD are calibrated at five levels from 0.001 ng to 0.2 ng.

PCB's by GC/ECD are calibrated at five levels from 1 ng to 10 ng.

In all cases reference is made to the specific SOP for preparation directions.

Continuing Calibration (GC/MS and GC)

A continuing calibration standard containing all volatile or semivolatile compounds as well as all required internal standards and surrogates, is performed each 12 hours during analysis. This applies to all matrices except air, whose requirements are detailed in EPA method TO15. Compare the RF data from the standards each 12 hours with the average RF from the initial calibration for a specific instrument. A system performance check must also be made each 12 hours. If the SPCC criteria are met, a comparison of RFs is made for all compounds. This is the same check that is applied during the initial calibration. If the minimum response factors are not met, the system should be evaluated and corrective action should be taken before sample analysis begins. See the specific SOP for criteria.

5.4.6.1.15 Calibration of the Gas Chromatograph

Calibration of the gas chromatograph (GC) for pesticide and polychlorinated biphenyl (PCB) or other organic compound analyses is performed with the standardization of the instrument. A five-point standard curve is utilized.

Response factors are to be calculated for each compound at each concentration level. These RF will be averaged to generate the mean daily RF for each compound over the range of the standard curve. The mean response factor will be used to calculate the sample concentration of the compound of interest. When sample responses exceed the range of the standard curve, the sample will be diluted to fall within range of the standard curve and be reanalyzed. The results of the daily GC standardization will be tabulated and filed with the corresponding sample analyses or batch file.

5.4.6.1.16 Calibration of Inductively Coupled Plasma Spectrometer (ICP) and Inductively Coupled Argon Plasma/Mass Spectrometer (ICP/MS) and Cold Vapor AAS

The ICPs and ICP/MSs are standardized for the metal of interest by the analysis of a set of calibration standards prepared by diluting a stock solution of known concentration. A single standard is used to calibrate the ICP, three standards are used for ICP/MS, while five working standards of mercury (Cold Vapor AAS) are prepared by dilution of the stock standard. The concentration of the calibration standards is chosen so as to cover the working range of the instrument. Subsequently all sample measurements are made within this working range. Once the working standards are prepared, they are analyzed on the ICP or AAS and the instrument response is calibrated to provide a direct readout in micrograms of metal per milliliter of water or parts per million.

Once the instrument has been initially calibrated, the analysis of initial calibration verification (ICV) is performed. Continuing calibration verification (CCV) standards are repeated after every ten samples during sample analysis to verify instrument response during analysis and to confirm the calibration. A typical analysis sequence is presented below:

< Working standards are prepared by dilution of a stock standard solution of the metal of interest.

< A calibration curve within the working range of the instrument is established by analysis of five working standards (one for ICP).

< The working standards (ICV, CCV and blank) are reanalyzed to confirm calibration. If the calibration is not confirmed, within SOP limits, the instrument is recalibrated.

< The samples are analyzed for the metals of interest.

< Following completion of the sample analyses, the working standards are reanalyzed to confirm calibration. If calibration is confirmed, the analysis is

completed. However, if the calibration is not confirmed, the problem is corrected, and the affected samples are reanalyzed.

5.4.6.1.17 PERIODIC CALIBRATION

Periodic calibration shall be performed for instrumentation such as balances, thermometers, ovens, and furnaces that are required in analytical methods, but which are not routinely calibrated as part of the analytical procedure. Documentation of calibration is kept for each instrumentation item.

Calibration requirements are determined within the York laboratory depending upon the instrumentation used and its operating function. Following are brief example discussions for the calibration of balances and thermometers with examples of calibration data sheets to serve as a guideline for the preparation of laboratory-specific procedures.

5.4.6.1.18 Balances (Example Procedure)

All balances are verified by using weights traceable to the National Bureau of Standards (NIST) on use. Calibration weights shall be Class S or better and shall be recertified every year. If balances are calibrated by an external agency, verification of their weights shall be provided.

Calibration of balances shall be over the range in which they are most commonly used. The weighs used for calibration of each balance shall be 0.5g, 2.0g, 10.0g, 20.0g, and 100g. Acceptance for balances which are direct reading to 0.01 gram shall be ± 0.01g, to 0.0001g shall be ± 0.007g, and to 0.00001g shall be ± 0.0007g.

5.4.6.1.19 Thermometers (Example Procedure)

Certified, or reference, thermometers shall be maintained for use in calibrating working thermometers including other temperature measurement devices such as thermocouples, probes and infrared temperature sensors. Reference thermometers shall be provided with NIST traceability for initial calibration and shall be recertified every year with instrumentation directly traceable to the NIST. Working thermometers shall be compared with reference thermometers every 12 months. In addition, working thermometers shall be visually inspected by laboratory personnel prior to use.

Calibration temperatures and acceptance criteria shall be based upon the working range of the thermometer and the accuracy required for its use.

5.4.6.2 Testing Uncertainties

Policy:
The SOP ADMINESTUNCERT043010 is utilized to estimate uncertainties of measurement in testing, except when the test methods preclude such rigorous calculations. For most environmental analyses these uncertainties have been established and this procedure will be unnecessary.

In certain cases it is not possible to undertake metrologically and statistically valid estimations of uncertainty of measurement. In these cases the laboratory attempts to identify all the components of uncertainty and make the best possible estimation, and ensure that the form of reporting does not give an exaggerated impression of accuracy. Reasonable estimation is based on knowledge of the performance of the method and on the measurement scope and makes use of previous experience and validation data.

Details:
The degree of rigor needed in an estimation of uncertainty of measurement depends on factors such as:

- requirement of the test method
- requirement by the client
- if there are narrow limits on which decisions on conformity to a specification are based

In cases where a well-recognized test method specifies limits to the values of the major sources of uncertainty of measurement and specifies the form of presentation of calculated results, the laboratory is considered to have satisfied the estimation uncertainty of measurement by following the reporting instructions (see section 5.10).

5.4.6.3 Uncertainty Components

Policy:
When estimating the uncertainty of measurement, all uncertainty components that are of importance in the given situation are taken into account using accepted methods of analysis.

Details:
Sources contributing to the uncertainty include, but are not necessarily limited to, the reference standards and reference materials used, methods and instrumentation used, the environmental conditions, the item being tested or calibrated and the operator.

The predicted long-term behavior of the tested and/or calibrated item is normally not taken into account when estimating the measurement uncertainty.

For further information, see ISO 5725 and the Guide to Expression of Uncertainty in Measurement.

5.4.7 Control of Data

5.4.7.1 Calculations and Data Transfers

Policy:
Calculations and data transfers are subject to appropriate checks in a systematic manner.

Details:
Test data are validated through the following to determine accuracy of calculations, conversions, and data transfers

- checks for transcription errors, omissions, and mistakes
- checks to determine consistency with normal or expected values

For those analyses where manual data reduction is required, it is performed according to the instructions provided in the test method or SOP.

5.4.7.2 Computers and Automated Instrumentation

Policy:
When computers or automated instrumentation are used for the acquisition, processing, manipulation, recording, reporting, storage or retrieval of test or calibration data, the laboratory ensures that:

- computer software developed by the user is documented in sufficient detail and suitably validated or otherwise checked as being adequate for use
- procedures are established and implemented for protecting the integrity of data; such procedures include, but are not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission, and data processing (see section 4.13.1.4)
- computers and automated instrumentation are maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of test and calibration data
- data is securely maintained by preventing unauthorized access to, and unauthorized amendment of, computer records
- Data are backed up both on-site and off site at a frequency that allows minimal loss in the event of catastrophic failure.

Details and Procedures:
Data generated using computer software programs that are interfaced directly to instruments incorporates all dilutions and calculations, thereby eliminating the need for manual data reduction. This coupled with preparation parameters done through the LIMS system yield the final results.

Commercially developed software in general use within its designed application range may be considered sufficiently validated. Laboratory software configuration / modifications are validated and documented.

Electronic records, electronic signatures, and handwritten signatures executed to electronic records must be equivalent to proper records and handwritten signatures to paper and are validated by procedures in 21 CFR. Part II (Docket No. 92NO251) RIN0910-AA29; Federal Register: March 20, 1997, Volume 62, Number 54), Rules and Regulations, pages 13429-13466 and updates. For further details see:

http://www.fda.gov/ora/compliance_ref/part11/

Revision History

Revision 2.0	04/30/2010	First Issue of Rewritten Quality Manual
Revision 2.1	06/29/2012	Modified balance calibration procedure, tolerances.

5.5 Instrumentation

5.5.1 Required Instrumentation

Policy:
The laboratory is furnished with all items for preparation and analysis required for the correct performance of the analyses. When instrumentation is used outside the laboratory's permanent control, it ensures that the requirements of this Quality Manual are met.

Details:
Instrumentation is used in an environment appropriate to its proper performance. All instrumentation required by a test is described in each method, including instrumentation tolerances.

5.5.2 Required Accuracy

Policy:
Instrumentation and software used for testing are capable of achieving the accuracy required and comply with specifications relevant to the tests and/or calibrations concerned. Calibration programs are established for key quantities or values of the instruments where these properties have a significant affect on the results. When received, instrumentation is checked to establish that it meets the laboratory's specification requirements, complies with the relevant standard specifications, and is checked and/or calibrated in accordance with section 5.6 before use.

Details:
The procedures for checking newly received instrumentation are as determined by manufacturers' specification and/or those determined by the laboratory during procurement.

5.5.3 Authorized Personnel

Policy:
Instrumentation is operated by authorized personnel. Up-to-date instructions on the use and maintenance of instrumentation (including any relevant manuals provided by the manufacturer of the instrumentation) are readily available for use by the appropriate laboratory personnel.

Details:
Access to laboratory instrumentation is controlled to ensure that only authorized personnel use instrumentation.

5.5.4 Unique Identification

Policy:
Each item of instrumentation used for testing is uniquely identified as appropriate.

Details:
Measuring and testing instrumentation is uniquely identified through an asset number or ID. Measuring and testing instrumentation includes any instrument that could affect the quality of test results. Components that can be interchanged between various instruments are tracked in instrumentation logbooks but are not assigned individual asset numbers.

5.5.5 Inventory and Maintenance Records

Policy:
Records are maintained for each item of instrumentation significant to the tests and/or calibrations performed. The records include the following:

- identity of the item of instrumentation (and its software)
- manufacturer’s name, type identification, and serial number and/or other unique identification
- checks that instrumentation complies with the specification (see section 5.5.2)
- current location, where appropriate
- the manufacturer’s instructions, if available, or reference to their location
- dates, results and copies of reports and certificates of all calibrations, adjustments, acceptance criteria, and due date of next calibration
- maintenance carried out to date and the maintenance plan (includes calibration)
- damage, malfunction, modification or repair to the instrumentation

Details:
Either manual log books are maintained or a database is used to capture the above inventory information. The above information related to service and maintenance is kept in individual instrumentation files and/or binders. Other information kept in these files and/or binders may include:

- date received and date placed in service
- condition when received (e.g., new, used, refurbished)
- dates and results of calibration and/or verification and date of next calibration and/or verification or tuning
- performance history, where appropriate (e.g., response time, drift, noise level)

5.5.6 Instrumentation Procedures

Policy:
The laboratory has as an established plan for use and maintenance (including calibration) of measuring instrumentation, and appropriate use of correction factors to ensure proper functioning and in order to prevent contamination or deterioration.

Details and Procedures:
The procedures for each piece of measuring instrumentation are located in the appropriate room where the instrumentation is located or in the SOP. These procedures detail any information for safe handling, transport, storage, use, and maintenance of measuring instrumentation.

5.5.7 Out of Service Instrumentation

Policy:
Instrumentation that has either been subjected to overloading or mishandling, or gives suspect results, or has been shown to be defective or outside specified limits, is taken out of service, clearly marked, and appropriately stored until it has been repaired and shown by calibration or test to perform correctly.

Details:
Routine testing work is completely discontinued on instrumentation that even shows minor nonconformance. Not only do we do this for ethical reasons in support of our client, but minor nonconformances are often indicative of impending major breakdowns in expensive instrumentation. These breakdowns need to be avoided wherever possible.

Out of service instrumentation is clearly marked as outlined in section 5.5.8.

The laboratory examines the effect of the defect or departure from specified limits on previous test and/or calibrations and institutes the “Control of Nonconforming Work” procedure as outlined in section 4.9.

5.5.8 Calibration Status

Policy:

Instrumentation requiring calibration is labeled to indicate the calibration status and/or operational status and the date when re-calibration is due when appropriate. This is not normally applicable to organics analysis instrumentation, and more applies to balances and temperature devices.

Details:
Calibration labels have a write-on surface and a pressure sensitive adhesive. The areas that are filled out include the person who performed the calibration, the date it was performed, the date it is due for re-calibration, and the instrumentation's identification number. An example label that may be used is shown.

CALIBRATION
BY____________DATE__________
DUE___________ID#____________

Measuring instrumentation that has failed calibration or is deemed out of service is labeled with one of the following labels:

CALIBRATION VOID

DO NOT USE

OUT OF SERVICE

DO NOT USE

A piece of instrumentation that is not calibrated or checked is labeled with the following label:

FOR REFERENCE ONLY

5.5.9 Return to Service

Policy:
When instrumentation goes outside the direct control of the laboratory for a period, the laboratory ensures that the function and calibration status of the instrumentation are checked and validated and shown to be satisfactory before the instrumentation is returned to service.

Details and Procedures:
The procedures used to check and ensure that the function and calibration status of the instrumentation are satisfactory before the instrumentation is returned to service are

outlined in the manufacturer’s instrumentation manual. Any additional quality control checks are outlined in the applicable section of the appropriate SOP and/or test method.

5.5.10 Periodic Checks

Policy:
When intermediate checks are needed to maintain confidence in the calibration status of instrumentation, these checks are carried out periodically according to defined procedure.

Details and Procedures:
As stated in section 5.5.6, the procedures for each piece of measuring instrumentation are detailed in the related SOPs. Internal quality control checks are specified in individual test methods that are located in the appropriate laboratory areas thereby providing procedures for intermediate checks.

5.5.11 Correction Factors

Policy
Calibrations that give rise to a set of correction factors are updated along with all copies of this data (e.g., in computer software).

Details and Procedures:
The updating of correction factors, including all copies, is assured by following the appropriate test method or SOP. It is the responsibility of the Group Leaders to ensure that all copies are updated.

5.5.12 Safeguards against Adjustments

Policy:
Test instrumentation, including hardware and software, are safeguarded from adjustments that invalidate test and/or calibration results/status.

Details:
Safeguards against adjustment for laboratory instrumentation include:

- detailed SOPs and manufacturer’s manuals on the operation of the instrumentation
- policies permitting only fully trained and competent personnel to operate instrumentation
- access to the laboratory is restricted to authorized personnel

Safeguards against adjustment for software include:

- password protection for important files and packages
- access to the laboratory is restricted to authorized personnel

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.6 Measurement Traceability

5.6.1 General

Policy:
All measurement and test instrumentation having an effect on the accuracy or validity of tests is calibrated and/or verified before being put into service.

Details:
The program includes a system for selecting, using, calibrating, checking, controlling, and maintaining:

- measurement standards
- reference standards used as measurement standards
- measuring and test instrumentation used to perform tests and calibrations

Procedures are documented where appropriate. All measurements that play a defining role in testing accuracy are based directly or indirectly on reference standards, reference materials, certified reference materials, or other standards or materials having appropriate traceability.

Records are maintained for each standard. These records include, as applicable:

- supplier, grade, batch#
- dates of preparation or verification
- measurement of weights, volumes, time intervals, temperatures, and pressures and related calculations
- relevant processes (e.g., pH adjustment, extraction)
- verification results
- identification of personnel involved

Reagents prepared in the laboratory are labeled to identify substance, concentration, solvent (where not water), any special precautions or hazards, restrictions of use, Lot no., and date of preparation and/or expiry. The person responsible for the preparation of the reagent is identified either from the label or from records.

5.6.2 Specific Requirements

5.6.2.1 Calibration

Policy:
The program for calibration of instrumentation is designed and operated to ensure that calibration measurements are traceable to the Système International (SI) units of measurement or NIST, where appropriate or practical.

Details:
Traceability of measurement is assured by the use of calibration services, internal and from sources that can demonstrate competence, measurement capability and traceability. The calibration certificates issued by these sources show that there is a link to a primary standard traceable to NIST. The calibration certificates contain the measurement results including the measurement uncertainty and/or a statement of compliance with an identified metrological specification (see also section 5.10.4.2).

Calibration vendors accredited to ISO 17025 or A2LA or equivalent are considered competent to provide the appropriate calibration services.

The term “identified metrological specification” means that it must be clear from the calibration certificate against which specification the measurements have been compared with, by including the specification or by giving an unambiguous reference to the specification.

When the terms “international standard” or “national standard” are used in connection with traceability, it is assumed that these standards fulfil the properties of primary standards for the realization of SI units.

Maintain certificates of all reference standards, measuring instrumentation, or certified reference material used in ensuring traceability. Where traceability to national standards of measurement is not applicable, the laboratory provides satisfactory evidence of correlation of results, for example by participation in a suitable program of inter-laboratory comparisons or proficiency testing.

Reference standards, such as thermometers and weights, are traceable to a national or international standard (e.g., NIST).

5.6.2.2 Testing

5.6.2.2.1

Policy:
The requirements given in section 5.6.2.1 apply to measuring and test instrumentation with measuring functions used, unless it has been established that the associated calibration uncertainty contributes little to the total uncertainty of the test result. When this situation arises, the laboratory ensures that instrumentation used can provide the accuracy of measurement needed.

Details:
The extent to which the requirements in section 5.6.2.1 are followed depends on the relative contribution of calibration uncertainty to the total uncertainty. If calibration is the dominant factor, the requirements are strictly followed. If, however, calibration is not one of the major contributors to the total uncertainty, other ways for providing confidence may be used, as given in section 5.6.2.2.2.

5.6.2.2.2

Policy:
Where traceability to SI units of measurement is not possible and/or not relevant, other means for providing confidence in the results are applied such as:

- the use of suitable reference materials certified to give a reliable characterization of the material
- mutual-consent standards or methods which are clearly specified and agreed upon by all parties concerned
- participation in a suitable program of inter-laboratory comparisons or proficiency testing

Details:
Reliable characterization involves an estimate of recovery.

The laboratory participates in proficiency testing and/or check sample programs. The list of programs is maintained by the Quality Assurance Officer and includes NYSDOH NELAP, CTDOH Proficiency Program, and NJDEP Office of Quality Assurance for TO-15 air and NJDEP EPH.

5.6.3 Reference Standards and Reference Materials

5.6.3.1 Reference Standards

Policy:
Reference standards are obtained or calibrated by a body that can provide traceability as described in section 5.6.2.1. For our use traceability to NIST is acceptable for most applications. Such reference standards of measurement held by the laboratory are used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

Details:
Reference standards are obtained from the National Institute of Standards and Technology (NIST), if applicable, or suppliers referencing NIST traceability with appropriate documentation.

5.6.3.2 Reference Materials

Policy:
Where possible, reference materials are traceable to SI units of measurement, or to certified reference materials. Internal reference materials are checked as far as is technically and economically practicable. Where possible all standards used for calibration of any kind are NIST traceable.

Details:
Reference materials, including calibration standards, used in chemical measurement are prepared so that the point of measurement is similar or equivalent to that of the samples. The matrix, prior to the addition of the analyte does not have a detectable concentration of the analyte. Reagents used in the preparation of reference materials, including calibration standards are of certified purity.

5.6.3.3 Intermediate Checks

Policy:
Checks needed to maintain confidence in the calibration status of reference, primary, transfer or working standards and reference materials are carried out according to defined procedures and schedules.

Details and Procedures:
The control check standards (Laboratory Control Samples) used to verify the accuracy of all the other standards are prepared independently from all the other standards used to establish the original calibration. These control check standards are prepared from a separate lot # or second source. It is the responsibility of the Group Leader to establish and maintain the individual schedule for each SOP and/or test method.

5.6.3.4 Transport and Storage

Policy:
The safe handling, transport, storage and use of reference standards and reference materials in order to prevent contamination or deterioration and in order to protect their integrity are defined.

Details:
Proper conditions are established for housing, handling, and care of reference standards/reference materials. All information needed to properly identify references appears on their housing, containers or in the SOP where applicable.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.7 Sample Handling, Receipt and Initiation

Laboratory analyses are performed to produce data representative of conditions when the sample was obtained. To provide representative samples for analysis, both field and laboratory personnel must satisfactorily perform their activities. Although the purpose of this manual is to define the laboratory Quality Systems, the interrelationship of field and laboratory operations in maintaining sample integrity is briefly discussed because the effect of field operations upon resulting data quality cannot be totally separated from laboratory operations.

5.7.1 CHAIN-OF-CUSTODY

An overriding consideration for resulting data is the ability to demonstrate that the samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Evidence of collection, shipment, laboratory receipt and laboratory custody until disposal must be documented to accomplish this. Documentation is accomplished through a chain-of-custody record that records each sample and the individuals responsible for sample collection, shipment, and receipt.
A sample is considered in custody if it is:

- In a person's actual possession.
- In view after being in physical possession.

- Secured so that no one can tamper with it after having been in physical custody.

- In a secure area, restricted to authorized personnel.

A chain-of-custody form is used by York personnel when shipping samples to subcontractors or to York's laboratory locations. This form is also used by all York's clients when submitting samples procured by the client. York does not accept samples collected by any outside or inside source without a correctly prepared chain-of-custody form.

The chain-of-custody form shall be signed by each individual who has the samples in their possession. Preparation of the chain-of-custody shall be as follows:

- The chain-of-custody record shall be initiated in the field by the person collecting the sample, for every sample. Every sample shall be assigned a unique identification number or name that is entered on the chain-of-custody form. Samples can be grouped for shipment and use a common form. The form allows for ten samples per page. If more than ten samples are shipped in the same container, more than one chain-of-custody form is required.

- The record shall be completed in the field to indicate project, sampling location, etc.

- If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for Relinquished By , Received By shall be completed in the field.

- The person transporting the samples to the laboratory or delivering them for shipment shall sign the record form as Relinquished By .

- If the samples are shipped to the laboratory by commercial carrier, the chain-of-custody form shall be sealed in a watertight zip-lock bag, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier.

- If the samples are directly transported to the laboratory, the chain-of-custody may be kept in possession of the person delivering the samples.

- For samples shipped by commercial carrier, the waybill shall serve as an extension of the chain-of-custody record between the final field Control Group and receipt in the laboratory.

- Upon receipt in the laboratory, the Sample Control Group, or representative, shall open the shipping containers, compare the contents with the chain-of-custody record, and sign and date the record. Any discrepancies shall be noted on the chain-of-custody form. Discrepancies are immediately discussed with the Project Manager for resolution.

- Chain-of-custody and any shipping records shall be maintained with the records for a specific project, becoming part of the project file.

5.7.2 <u>FIELD COLLECTION AND SHIPMENT</u>

York does not provide Field Collection services. Prior to collecting samples, the client's collection team must consider the analyses to be performed so that proper sample containers and shipping containers can be assembled and the proper preservatives added to containers. In addition, field logs and record sheets, chain-of-custody forms, and analysis request records must be assembled.

All records required for documentation of field collection must be completed by the client field team. Several of the documents that affect laboratory operations are discussed herein. The primary documenting record is the chain-of-custody as discussed above.

In addition to initiating the chain-of-custody form, field personnel are responsible for uniquely identifying (required on the chain-of-custody form) and labeling samples, providing proper preservation, and packaging samples to preclude breakage during transit by York couriers or client shipment.

Every sample shall be labeled to identify:

- Unique sample number (ex. 11F0565-01, -02, etc.)
- Sample Description (such as MW-1, etc.)
- Sampling date and time
- Person obtaining sample
- Container types and methods of sample preservation/conditioning
- Analyses required (e.g., VOC 8260B, etc.)

Samples must be placed in containers compatible with the intended analysis and properly preserved. Also, collection of samples must consider the time interval between acquiring the sample and analysis (holding time) so that the sample is representative. The requirements for various analytical parameters with respect to the type of container, quantity of sample, preservation method, and maximum holding time between collection and analysis, quantity of sample, are dictated by the Federal Register, EPA SW-846 or the specific Quality Assurance Project Plan (QAPP).

It is recommended to field personnel that shipping containers are to be sealed prior to shipment, whether shipped by direct transport by field personnel or commercial carrier. The only exception to this is if sufficient holding time exists so that the samples can be held in the field and it is necessary to re-ice the containers prior to or during transport.

As soon as field personnel are ready to hand off samples from the field to the courier, the courier takes custody of them and transfers them into a cooler containing ice or ice packs sufficient to maintain 2-6^{o}C until arrival at the laboratory. Upon receipt at the laboratory, the temperature (as measured by an infrared temperature probe) is recorded on the Chain-of-Custody form. In the LIMS log-in module, all other sample related conditions are noted in the appropriate fields.

It is imperative that the analyses requested by the client be clearly provided so that analytical requirements are maintained with respect to sample holding times and limits of detection needed.

5.7.3 LABORATORY SAMPLE RECEIPT

The first step in the laboratory receipt of samples is obtaining the proper information. The information is taken by the Client Services group, documented in ELEMENT and passed on (if not) immediately to the Sample Control. The Sample Control Group shall note that the shipment is expected and notify the Client Service sand Group Leaders when samples are received. This is especially important for HOLDING TIMES SENSITIVE parameters and RUSH requests where coordination is essential to meet project deadlines. These communications are done via the RUSH NOTIFICATION and HOLDING TIME SENSITIVE parameters forms.

Upon sample receipt, the Sample Control Group performs the following:

< 5.7.3.1 Examine all samples and determine sample temperature using an Infrared thermometer. This documents that proper temperature has been maintained during shipment (if applicable). Note this on the Chain-of-Custody. If samples have been damaged during shipment, the remaining samples shall be carefully examined to determine whether they were affected. Any samples affected shall be also considered damaged. It will be noted on the chain-of-custody record that specific samples were damaged and that the

samples were removed from the sampling program. Field personnel will be notified as soon as possible that samples were damaged and that they must be re-sampled, or the testing program changed, and an estimate of the cause of damage.

5.7.3.2< Compare samples received against those listed on the chain-of-custody. Note any deviations or problems and clarify with the Project Manager or Client Services. CONFIRM preservations has been properly done (chemical preservation) by the client in the field. If this is not the case, enter this into the appropriate field in Element and preserve the samples accordingly. The client receives a Sample Condition/Receipt Report detailing any issues encountered. The lab does not confirm the following chemical preservations upon receipt which are done at the bench: Oil & Grease and Volatile Organics.

5.7.3.4 Sign and date the chain-of-custody form and attach any shipping receipts to the chain-of-custody.

5.7.3.5 Log the project into the lab LIMS system.

<
< 5.7.3.6 Open a laboratory project number and pendaflex file which will contain:

- Project identification number
- Completed Chain-of-Custody record
- Shipping receipts
- Any correspondence related to the project
- WORK ORDER which will include:

    - Client Name
    - Client Project ID
    - Lab Sample numbers
    - Client Sample Identifiers
    - Type of samples (matrix)
    - Date received in laboratory
    - Parameters to be analyzed
    - Project Pricing
    - Any special instructions (such as EDDs, ASP B deliverables, etc.)

If samples collected by Clients arrive without chain-of-custody or incorrect chain-of-custody records, the following shall be done by the Sample Control Group:

If the chain-of-custody is incorrect, a memorandum to the Project Management/Client Services is prepared stating the inaccuracy and correction in the form of a Corrective Action (CA). The CA must be signed and dated by the person originating the chain-of-custody and the Sample Control Group. The memorandum will serve as an amendment to the chain-of-custody. If the information on the chain-of-custody form cannot be corrected by the Sample Control Group or the field personnel, the samples affected shall be removed from the sampling program.

< If the chain-of-custody is not shipped with the samples, the Client personnel shall be contacted and a memorandum prepared which lists the persons involved in collecting, shipping, and receiving the samples and the times, dates, and events. Each person involved must sign and date this memorandum. The complete memorandum will be maintained in lieu of the chain-of-custody.

5.7.4 LABORATORY STORAGE OF SAMPLES

The primary considerations for sample storage are:

< Maintenance of prescribed temperature, if required, which is typically 4^{o}C ± 2^{o}C; some parameters may require freezing (<7.0C)

< Extracting and/or analyzing samples within the prescribed holding time for the parameters of interest.

The requirements for temperatures and holding times shall be met. Placing of samples in the proper storage environment is the responsibility of the Sample Control Group, who should notify the Group Leaders if there are any samples which must be analyzed immediately because of holding time requirements. This is accomplished by issuing a HOLDING TIME SENSITIVE NOTIFICATION FORM.

5.7.5 INITIATION OF TESTING PROGRAM

As stated previously, the chain-of-custody form is prepared by the client and submitted with the samples to the laboratory. If the analytical program is not defined with the sample shipment, Sample Control shall immediately notify the Client Services who will contact the client to determine/clarify the testing program.

The analytical program or any changes requested shall be re-entered onto the original chain-of-custody form, signed and dated. This record serves as the master analytical request form for samples and the clients' authorization to proceed.

Client Services and the Group Leaders are responsible for prioritizing samples on the basis of holding time and required reporting time into the laboratory sample stream.

5.7.6 SAMPLE DISPOSAL

The LIMS allows us to set a sample status for disposal. These records are then maintained on a sample basis in the database. There are several possibilities for sample disposition:

< The sample may be completely consumed during analysis.

< Samples may be returned to the client or location of sampling for disposal.

< The samples may be stored after the analysis. Proper environmental control and holding time must be observed if reanalysis is anticipated. If reanalysis is not anticipated, environmental conditions for storage will not be observed.

The samples may be transferred to proper drums or waste containers for final disposal by licensed waste disposal firms.

The Sample Control Group shall determine disposition of samples if not specified in the project file.

In general, York will not maintain samples and extracts longer than thirty (30) days beyond completion of analysis, unless otherwise specified.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.8 Assuring the Quality of Test and Calibration Results

5.8.1 Quality Control / Quality Assurance

Policy:
Quality control procedures are utilized to monitor the validity of test results. These procedures are for each test method utilized in the laboratory. The resulting data are recorded so that trends are detectable (and where practicable, statistical techniques are applied to the reviewing of the results). This monitoring is planned and reviewed and may include, but not limited to, the following:

- regular use of certified reference materials and/or internal quality control using secondary reference materials
- participation in inter-laboratory comparisons or proficiency testing programs
- replicate tests or calibrations using the same or different methods
- re-testing or re-calibration of retained items
- correlation of results for different characteristics of an item

Details:
The methods utilized from the above list will be appropriate for the type and volume of the work undertaken. Records are maintained of assurance activities and any actions taken.

As a guide, for routine analyses the level of internal quality control is typically 5% of the sample throughput. For more complex procedures, 20% is not unusual and on occasions even 50% may be required. For analyses performed infrequently the use of a reference material containing a certified or known concentration of analyte, followed by replicate analyses of the sample and spiked sample is done. For analyses undertaken more frequently, systematic quality control procedures incorporating the use of control charts and check samples are implemented. These procedures are documented in the SOP for each test method.

Internal quality control schemes using statistics include:

- design of experimental/factorial analysis
- variation/regression analysis
- safety evaluation/risk analysis
- tests of significance
- quality control charts
- statistical sampling inspection

Proficiency testing helps to highlight not only repeatability and reproducibility performance between laboratories, but also systematic errors such as bias. It is important to monitor proficiency testing results as a means of checking quality assurance and take action as necessary.

The Quality Assurance Officer maintains a list of all the current proficiency testing programs the laboratory participates in, monitors the results, and notifies the appropriate personnel of both problematic and successful results.

Technical personnel use certified reference materials and other reference materials to evaluate test performance on a daily basis and include daily process control checks. These data are used to evaluate the validity of the test results.

Replicate tests may be used if suitable reference material is available. These materials and proficiency test materials are available for improving repeatability.

Re-testing of test items is performed occasionally at the discretion of the supervisor or when test results seem anomalous.

5.8.2 Correction and Prevention

Policy and Details:
Quality control data are analyzed and, where they are found to be outside pre-defined criteria, planned action is taken to correct and to prevent incorrect results from being reported.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

5.9 Reporting of Results

5.9.1 General

Policy:
The results of each test or series of tests are reported accurately, clearly, unambiguously and objectively, and in accordance with any specific instructions in the test or calibration methods. All Reporting functions are performed in the Stratford, CT location.
The results are reported, normally in a Technical Report and include all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used or regulatory body reviewing the data. This information may include what is outlined in section 5.9.2, 5.9.3 and 5.9.4.
In the case of tests performed for internal purposes, and in the case of a written agreement with the client, the results may be reported in a simplified way. The information listed in section 5.9.2 to 5.9.4, and not reported, is kept readily available.

Details:
Test reports are normally issued by electronic means (email or web access).

5.9.2 Test reports

Policy:
Test reports (Technical Reports) include the following information, as appropriate:

- a title (e.g., “Technical Report”
- name and address of laboratory, and location where tests were carried out if different from the address of the laboratory
- unique identification of the test report (such as a project no.), and on each page an identification in order to ensure that the page is recognized as a part of the test report, and a clear identification of the end of the test report
- name and address of the client
- identification of the method(s) used
- description, condition, and unambiguous identification of the sample(s) tested
- date of receipt of samples and date(s) of performance of the analyses
- reference to sampling procedures used by the laboratory or other bodies where these are relevant to the validity or application of the results
- test results with, where appropriate, units of measurement
- the name(s), function(s) and signature(s) or equivalent of person(s) authorizing the test report
- a statement to the effect that the results relate only to the items tested
- Notations for Certification by analyte, data qualifiers, and sample qualifiers

Details:
Signing authority for test reports is the responsibility of the Laboratory Director or designee.

Hard copies and electronic copies of test reports include the page number and total number of pages.

A statement is included specifying that the test report is not to be reproduced except in full, without written approval of the laboratory. Data reported to the client contains the appropriate significant digits for each test method. Low level data are identified as being below specified limits by utilizing appropriate flags.

5.9.3 Test Reports

5.9.3.1

Policy and Details:
In addition to the requirements listed in section 5.9.2, test reports include the following, where necessary for the interpretation of results:
- deviations from, additions to, or exclusions from the test method
- where relevant, a statement of compliance/non-compliance with requirements and/or specifications
- Clearly qualified non-compliant data or samples
- where applicable, a statement on the estimated uncertainty of measurement of the test result; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a client's instruction so requires, or when uncertainty affects compliance to a specification limit
- where appropriate and needed opinions and interpretations (see section 5.9.5)
- additional information required by specific methods, clients, or regulatory authorities.

5.9.3.2

Policy and Details:
In addition to the requirements listed in sections 5.9.2 and 5.9.3.1, test reports containing the results of sampling include the following, where necessary for the interpretation of test results:
- date of sampling
- unambiguous identification of substance, matrix, material sampled

- details of any environmental condition during sampling that may affect the interpretation of the test results
- any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned

5.9.5 Opinions and Interpretations

Policy:
When opinions and interpretations are included in the test report, the basis upon which the opinions and interpretations have been made is documented. Opinions and interpretations are clearly marked as such in the test report.

Note - Opinions and interpretations should not be confused with sample data reporting as intended in ISO/IEC 17020 and ISO/IEC Guide 65.

Details:
Opinions and interpretations included in a test report may comprise, but not be limited to the following:

- opinion on conformity of the results with requirements (lab non-conformances)
- fulfilment of contractual requirements
- recommendations on how to use the results
- guidance to be used for improvements
- Electronic Data Deliverables that compare results to regulatory limits

In many cases it is appropriate to communicate the opinions and interpretations by direct dialogue with the client. This dialogue is documented in writing.

5.9.6 Test Results Obtained from Subcontractors

Policy and Details:
Test reports containing the results of tests performed by subcontractors are clearly identified for the subcontracted results. The subcontractor reports the results either in writing or electronically to our laboratory.

5.9.7 Electronic Transmission of Results

Policy:
In the case of transmission of test results by telephone, facsimile or other electronic or electromagnetic means, the requirements of the policies and procedures of this Quality Manual continue to apply (see also 5.4.7).

Details:
Reports that are “published” electronically contain a digital signature.

5.9.8 Format of Reports

Policy:
The format of reports is designed to accommodate each type of test carried out and to minimize the possibility of misunderstanding or misuse.

Details:
The layout of the test report is such that the presentation of the test data facilitates ease of assimilation by the reader.

The headings are standardized as far as possible.

5.9.9 Amendments to Reports

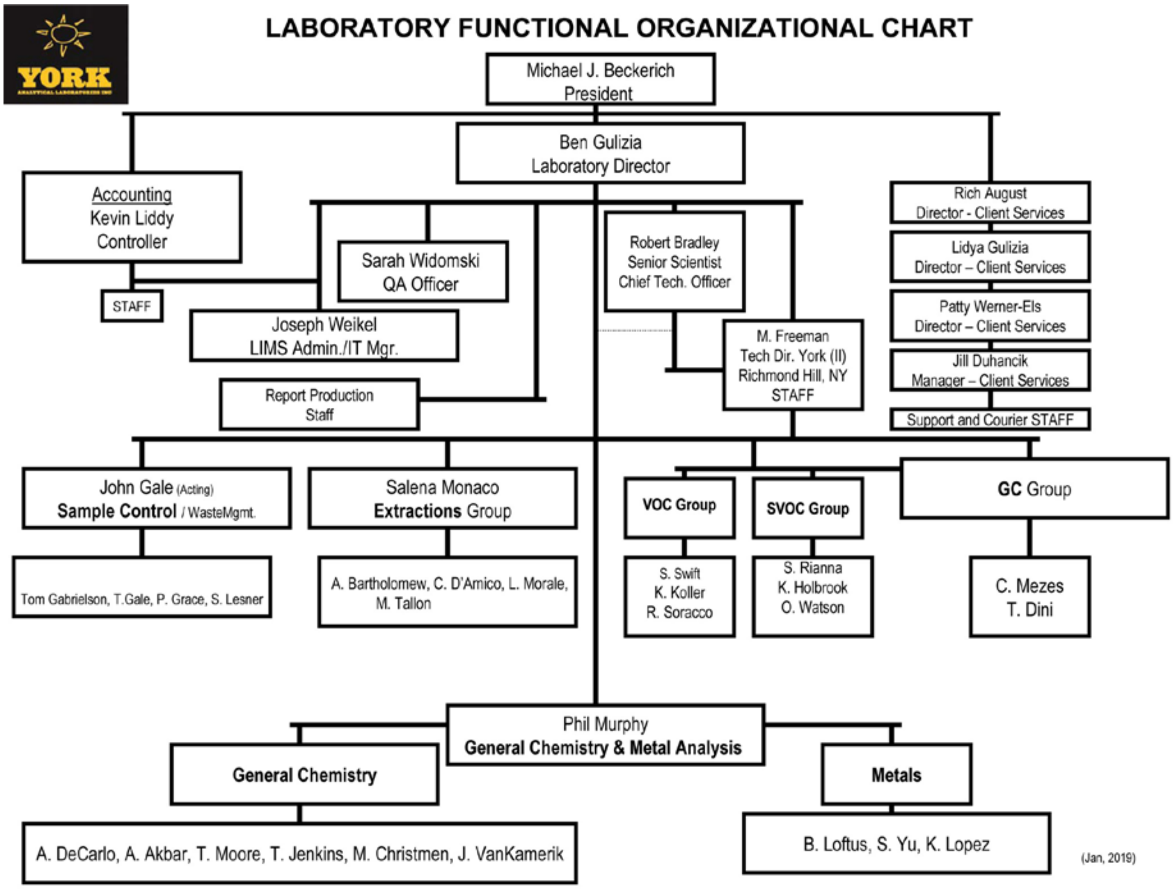
Policy:
Material amendments to a test report after issue are made only in the form of a further document, or data transfer, which includes the statement “Revision no. and includes a description of the revision in the notes section of the report.. Such amendments meet all the requirements in this Quality Manual.

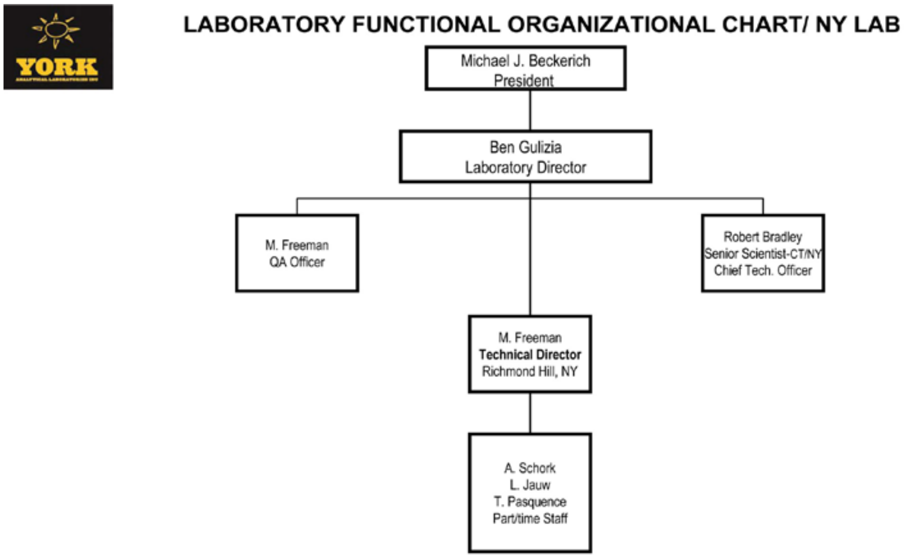
Details:
When it is necessary to issue a complete new test report, it is uniquely identified and contains a reference to the original that it replaces.

Revision History

Revision 2.0 04/30/2010 First Issue of Rewritten Quality Manual

ATTACHMENT A


LABORATORY FUNCTIONAL ORGANIZATIONAL CHART


LABORATORY FUNCTIONAL ORGANIZATIONAL CHART/ NY LAB

ATTACHMENT B

York Analytical Laboratories, Inc

MASTER LIST of SOPs-CONTROLLED DOCUMENTS on 01/22/2019

	Description	SOP No.	Date of Issue	Rev. No	Rev. Date
1	VOCs in AIR by EPA TO-14A/TO-15	GCMSAIR 111692	11/16/1992	9.7	01/15/2019
2	Cleaning of Summa Canisters	SummaClean111507	11/15/2007	1.4	01/15/2019
3	Calibration of Flow Controllers	FLOW CONT010312	1/3/2012	1.3	01/15/2019
		GC/MS - Volatiles			
1	Volatile Organics by GC/MS 8260/624	GCMS VOC 011700	1/17 /2000	3.6	01/31/2019
2	Volatiles in Drinking Water by GC/MS by EPA 524.2	GCMSVOC524.2 011700	1/17/2000	1.9	10/22/2012
3	Soil Sampling/Handling by EPA 5035A	GCMSVOC5035060712	6/7/ 2012	1.0	6/7/2012
		GC/MS - Semi-volatiles			
1	Semi-Volatiles using GC/MS by EPA 8270	GCMS SVOC	1/17 /2000	2.8	10/13/2014

Gas Chromatography					
1	PCBs using GC/ECD by EPA 8082A	GC PCB 011799	1/17/1999	1.7	12/01/2014
2	TPH-DRO using GC/FID by EPA 8015D	GC TPHDRO 091009	9/10/2009	1.4	7/7/2015
3	Pesticides using GC/ECD by EPA 8081B	GC Pest 011799	1/17/1999	1.6	8/5/2015
4	Herbicides using GC/ECD by EPA 8151A	GC Herb	1/19/1999	1.6	1/20/2015
5	Pesticides, PCBs in Potable Water using GC/ECD by EPA 505	505GCPest092010	9/20/2010	1.1	12/2/2014
6	CT-ETPH in Environmental Extracts	GC ETPH 111704	11/17/2004	1.6	2/29/2012
7	NJ EPH by NJDEP EPH 10/08-August 2010 Rev 3	GC NJEPH 032213	3/13/2013	1.0	
8	EDB, DBCP, TCP using GC/ECD by EPA 8011	GC EDB,DBCP 102413	10/24/2013	1.3	08/27/2015
9	GRO using GC/FID by EPA 8015D	GC GROFID 022715	02/27/2015	1.1	03/18/2016
Extractions					
1	Herbicide Extraction by EPA 8151A	EXT Herb	4/4/2013	1.2	12/19/2015
2	UltraSonic Extraction of solids by EPA 3550C	EXT SSVOC	5/26/2000	2.6	12/03/2014
3	ASE Extraction of solids by EPA 3545A	EXT SVOCSASE	8/31/2006	2.3	1/7/2015
4	Aqueous Extraction by EPA 3510C	EXT AqSVOC	5/26/2000	2.8	12/1/2014
5	Extraction Laboratory Glassware Washing Procedure	EXTGP052600	5/26/2000	1.1	4/3/2012
6	Soxhlet Extraction of solids for PCBs by EPA 3540C	EXT PCBSox	10/22/2010	1.1	1/5/2014
7	MA EPH Extraction of solids and waters	EXT MAEPHAQASE 121207	12/12/2007	2.0	10/22/2009
8	Spike and Surrogate Standard Preparation for Extractables	EXT SVOCStds	6/29/2012	1.3	5/31/2016
9	NJEPH Extraction of Waters and Soils	EXT NJEPH	3/22/2013	1.1	1/5/2014
10	Herbicide Extraction by SM6640B	EXT Herb	1/16/2014	1.1	

11	Microwave Extraction of solids by EPA 3546	EXT SSVOCMAE	06/10/2015	1.0	

Metals Analysis/Prep

1	ICP/MS Analysis of Sample Digestates by EPA 200.8 and SW-846 6020A	M ICPMS 080106	8/1/2006	1.4	6/1/2013
2	Prep of Samples for Metals Analysis by ICP and ICP/MS by SW-846 3010A, 3005A and 3050B	M SPrep 030695	3/6/1995	1.6	6/5/2015
3	ICP Analysis of Sample Digestates by EPA 200.7 and SW-846 6010C	M ICP 031195	3/11/1995	1.7	10/9/2015
4	Mercury Cold Vapor Technique by EPA 245.1, 245.2 and SW-846 7470A/7471B	M Hg 120998	12/10/1998	1.7	5/1/2013
5	Mercury Direct Technique by SW-846 7473	M Hg2	6/21/2013	1.2	6/17/2014
6	Prep of Samples for Metals Analysis by ICP and ICP/MS by SW-846 3010A,	M PrepMAD071715	7/17/2015	1.0	

Wet Chemistry/IC

1	Chemical Oxygen Demand (COD) [SM 5220D]	WC COD	10/4/2000	2.3	4/29/2014
2	TKN, Ammonia and TON [SM 4500-N_{org} C, 4500-NH_3 D]	WC TKN	10/4/2000	1.6	1/5/2014
3	Reactivity-Cyanide [SW-846 Ch 7.3.3]	WC CNR 080800	8/8/2000	1.3	10/22/2015
4	Hexavalent Chromium [SW-846 7196A, 3060A]	WC Cr+6	7/9/2000	1.5	1/5/2014
5	Total Cyanide [SM 4500-CN, SW-846 9014, 9010C]	WC CNT	7/9/2000	1.8	10/31/2015
6	Reactivity-Sulfide [SW-846 Ch 7.3.3]	WC ReacSulf 061296	6/12/1996	1.4	10/22/2015
7	Alkalinity [SM 2320B]	WC T-Alk	2/26/2000	1.5	1/02/2015
8	Hexane Extractable Material [EPA 1664]	WC HemGrav	11/16/2006	1.8	6/8/2015
9	Ion Chromatography [EPA 300.0]	WC IC	1/14/2000	2.0	10/22/2015
10	Biochemical Oxygen Demand (BOD) [SM 5210B]	WC BOD	1/17/2000	1.6	2/10/2015
11	TSS / VSS in Aqueous Samples [SM 2540D, E]	WC TSS	4/7/1995	1.6	8/27/2014
12	pH [SW-846 9040C, 9045D]	WC pH	4/6/1995	1.6	1/5/2014

13	T-Phosphorous and Ortho-Phosphate [EPA 365.3, SM 4500]	WC Phos	5/10/2000	1.6	5/1/2015
14	TCLP / SPLP Extraction [SW-846 1311, 1312]	WC TCLPEX	1/4/2000	1.5	1/20/2014
15	Cyanide Amenable to Chlorination [EPA 335.1]	WC CNA	11/4/2000	1.4	10/15/2014
16	Ignitability of Solids	WC IGN 040795	4/7/1995	1.2	10/17/2014
17	Flash Point [SW-846 1010A]	WC FP	4/7/1995	1.5	1/5/2013
18	Methylene Blue Active Substances (MBAS) [SM 5540C]	WC MBAS	4/26/2010	1.2	1/5/2014
19	TS, VS, TDS in Aqueous Samples [SM 2540B, C, E]	WC TSTDS	4/26/2010	1.4	8/24/2014
20	Color	WC Color	4/26/2010	1.1	12/12/2013
21	Glassware Washing	WC GlassPrep	9/2/1999	2.1	12/16/2013
22	Total Phenols (Low Level) [EPA 420.1]	WC PhenolsLL	10/27/2011	1.5	1/5/2014
23	Total Phenols [EPA 420.1]	WC Phenols	2/29/2012	1.4	1/5/2014
24	Conductivity [EPA 120.1]	WC Cond	2/29/2012	1.3	1/5/2014
25	Turbidity [EPA 180.1]	WC Turbidity	2/29/2012	1.5	1/28/2014
26	TS, FS, VS and % Moisture in Soil Samples [SM 2540G]	WC TS%M 022912	2/29/2012	1.1	9/18/2012
27	Extractable Organic Halogens in solids [SW-846 9023]	WC EOX 041112	4/11/2012	1.2	11/9/2012
28	Total Organic Carbon in Aqueous Samples [SM 5310C]	WC TOC	4/18/2012	1.3	4/29/2014
29	Oxidation-Reduction Potential [ASTM D1498-08]	WC ORP 031213	3/12/2013	1.0	
30	Settleable Solids [SM 2540F]	WC SetSol	5/24/2013	1.2	1/5/2014
31	Sulfide [SM 4500-S F]	WC Sulfide	5/24/2013	1.1	1/5/2014
32	Nitrate and Nitrite by Skalar	WC NOxSK	3/7/2014	1.1	6/24/2014
33	Chlorine Demand [SM 2350B]	WC Cl Demand	4/9/2014	1.0	

34	Ammonia TKN by Skalar	WC NH3TKN SK	12/11/2014	1.0	
35	Free Liquids	WC Free Liquids	3/4/2016	1.0	
	General Laboratory				
1	MDL Studies, Organics	GL MDL 113005	11/30/2005	1.3	3/12/2012
2	Chemical Expiration Dates	GL ExpDt 041812	4/18/2012	1.0	
3	LOQ/LOD Determination	GL LODLOQ	10/23/2013	1.3	6/9/2016
	Sample Control				
1	Sample Control Procedures	SC Proc	1/15/2001	2.5	5/27/2015
2	Sample Collection (drinking water only)	SC 08/09/2000	8/9/2000	1.0	
3	Sample Handling and Chain-of-Custody for Sample Couriers	SC Couriers 091207	9/12/2007	1.0	
	Administration				
1	Laboratory Safety and Health	Safety011600	1/16/2000	1.0	
2	Purchasing	ADMIN Purchasing 043010	4/18/2012	1.2	4/11/2013
3	QC Review/Evaluation of Data	QC040402	4/4/2002	1.1	4/30/2010
4	Ethics & Legal Responsibilities	ADMIN Ethics	4/1/2002	1.4	3/13/2014
5	Training of Personnel	ADMIN Training 080206	8/6/2006	1.4	9/4/2014
6	Manual Integration of Chromatographic Data	ADMIN Integration 09/11/07	9/11/2007	2.1	2/9/2012

7	Laboratory Notebook Control and Use	ADMIN LabNote 091107	9/12/2007	1.1	1/31/2013
8	Control of Records	ADMIN Records 043010	4/30/2010	1.1	11/9/2012
9	Control of Nonconforming Work	QSP 4-9-1	4/30/2010	1.0	
10	Management Review	ADMIN MgmtReview 043010	4/30/2010	1.0	
11	Internal Quality Audit`	ADMIN Audit 043010	4/30/2010	1.1	12/31/2013
12	Estimation of Uncertainty	ADMIN EstUncert 043010	4/30/2010	1.1	10/17/2014
13	Document Control	ADMIN Doc 043010	4/30/2010	1.2	6/2/2012
14	Corrective Action	ADMIN Corraction 043010	4/30/2010	1.1	11/6/2013
15	Complaints	QSP 4-8-1	4/30/2010	1.0	
16	Review of Chromatographic Data for Detection of Manual Re-Integration Issues	ADMIN ManIntReview 043010	4/30/2010	1.0	
17	Additional Policies/Procedures	Additional Policies 05/07/10	5/7/2010	1.2	10/17/2014
18	EDDs and Reports for Client Connect	ADMIN EDDRptCC 091610	9/16/2010	1.0	
20	Standard Prep in Element	ADMIN STD 031816	4/15/2016	1.0	
	Quality Manual				
1	York Quality Systems Manual-ISO-17025/NELAC	Quality Manual	1/4/1996	2.8	01/22/2019

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Fuel Additives

Methyl tert-butyl ether	EPA 524.2
Naphthalene	EPA 524.2

Metals I

Arsenic, Total	EPA 200.8 Rev. 5.4
Barium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Cadmium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Chromium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Copper, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Iron, Total	EPA 200.7 Rev. 4.4
Lead, Total	EPA 200.8 Rev. 5.4
Manganese, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Mercury, Total	EPA 245.1 Rev. 3.0
Selenium, Total	EPA 200.8 Rev. 5.4
Silver, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Zinc, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Metals II

Aluminum, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Antimony, Total	EPA 200.8 Rev. 5.4
Beryllium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Molybdenum, Total	EPA 200.8 Rev. 5.4
Nickel, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4
Thallium, Total	EPA 200.8 Rev. 5.4
Vanadium, Total	EPA 200.7 Rev. 4.4
	EPA 200.8 Rev. 5.4

Metals III

Calcium, Total	EPA 200.7 Rev. 4.4
Magnesium, Total	EPA 200.7 Rev. 4.4
Potassium, Total	EPA 200.7 Rev. 4.4
Sodium, Total	EPA 200.7 Rev. 4.4

Miscellaneous

Turbidity	EPA 180.1 Rev. 2.0

Non-Metals

Alkalinity	SM 21-23 2320B (-97)
Calcium Hardness	EPA 200.7 Rev. 4.4
Chloride	EPA 300.0 Rev. 2.1
Color	SM 21-23 2120B (-01)
Fluoride, Total	EPA 300.0 Rev. 2.1
Orthophosphate (as P)	EPA 300.0 Rev. 2.1
	SM 19, 21-23 4500-P E (-99)

Serial No.: 59447

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Non-Metals

Solids, Total Dissolved	SM 21-23 2540C (-97)
Specific Conductance	EPA 120.1 Rev. 1982
Sulfate (as SO4)	EPA 300.0 Rev. 2.1

Trihalomethanes

Bromodichloromethane	EPA 524.2
Bromoform	EPA 524.2
Chloroform	EPA 524.2
Dibromochloromethane	EPA 524.2

Volatile Aromatics

1,2,3-Trichlorobenzene	EPA 524.2
1,2,4-Trichlorobenzene	EPA 524.2
1,2,4-Trimethylbenzene	EPA 524.2
1,2-Dichlorobenzene	EPA 524.2
1,3,5-Trimethylbenzene	EPA 524.2
1,3-Dichlorobenzene	EPA 524.2
1,4-Dichlorobenzene	EPA 524.2
2-Chlorotoluene	EPA 524.2
4-Chlorotoluene	EPA 524.2
Benzene	EPA 524.2
Bromobenzene	EPA 524.2
Chlorobenzene	EPA 524.2
Ethyl benzene	EPA 524.2
Hexachlorobutadiene	EPA 524.2
Isopropylbenzene	EPA 524.2
n-Butylbenzene	EPA 524.2

Volatile Aromatics

n-Propylbenzene	EPA 524.2
p-Isopropyltoluene (P-Cymene)	EPA 524.2
sec-Butylbenzene	EPA 524.2
Styrene	EPA 524.2
tert-Butylbenzene	EPA 524.2
Toluene	EPA 524.2
Total Xylenes	EPA 524.2

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 524.2
1,1,1-Trichloroethane	EPA 524.2
1,1,2,2-Tetrachloroethane	EPA 524.2
1,1,2-Trichloroethane	EPA 524.2
1,1-Dichloroethane	EPA 524.2
1,1-Dichloroethene	EPA 524.2
1,1-Dichloropropene	EPA 524.2
1,2,3-Trichloropropane	EPA 524.2
1,2-Dichloroethane	EPA 524.2
1,2-Dichloropropane	EPA 524.2
1,3-Dichloropropane	EPA 524.2
2,2-Dichloropropane	EPA 524.2
Bromochloromethane	EPA 524.2
Bromomethane	EPA 524.2
Carbon tetrachloride	EPA 524.2
Chloroethane	EPA 524.2
Chloromethane	EPA 524.2

Serial No.: 59447

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Volatile Halocarbons

cis-1,2-Dichloroethene	EPA 524.2
cis-1,3-Dichloropropene	EPA 524.2
Dibromomethane	EPA 524.2
Dichlorodifluoromethane	EPA 524.2
Methylene chloride	EPA 524.2
Tetrachloroethene	EPA 524.2
trans-1,2-Dichloroethene	EPA 524.2
trans-1,3-Dichloropropene	EPA 524.2
Trichloroethene	EPA 524.2
Trichlorofluoromethane	EPA 524.2
Vinyl chloride	EPA 524.2

Serial No.: 59447

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NELAP RECOGNIZED ACCREDITATION BODY

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Acrylates	
Acrolein (Propenal)	EPA 8260C EPA 624.1
Acrylonitrile	EPA 8260C EPA 624.1
Methyl methacrylate	EPA 8260C
Amines	
1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 625.1 EPA 8270D
Carbazole	EPA 625.1 EPA 8270D
Diphenylamine	EPA 8270D
Pyridine	EPA 625.1 EPA 8270D
Benzidines	
3,3'-Dichlorobenzidine	EPA 625.1 EPA 8270D
Benzidine	EPA 625.1 EPA 8270D

Chlorinated Hydrocarbon Pesticides	
4,4'-DDD	EPA 8081B EPA 608.3
4,4'-DDE	EPA 8081B EPA 608.3
4,4'-DDT	EPA 8081B EPA 608.3
Aldrin	EPA 8081B EPA 608.3
alpha-BHC	EPA 8081B EPA 608.3
alpha-Chlordane	EPA 8081B
beta-BHC	EPA 8081B EPA 608.3
Chlordane Total	EPA 8081B EPA 608.3
delta-BHC	EPA 8081B EPA 608.3
Dieldrin	EPA 8081B EPA 608.3
Endosulfan I	EPA 8081B EPA 608.3
Endosulfan II	EPA 8081B EPA 608.3
Endosulfan sulfate	EPA 8081B EPA 608.3
Endrin	EPA 8081B

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Chlorinated Hydrocarbon Pesticides

Endrin	EPA 608.3
Endrin aldehyde	EPA 8081B EPA 608.3
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B EPA 608.3
Heptachlor epoxide	EPA 8081B EPA 608.3
Lindane	EPA 8081B EPA 608.3
Methoxychlor	EPA 8081B EPA 608.3
Mirex	EPA 8081B
Toxaphene	EPA 8081B EPA 608.3

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D
1,2,4-Trichlorobenzene	EPA 625.1 EPA 8270D
2-Chloronaphthalene	EPA 625.1 EPA 8270D
Hexachlorobenzene	EPA 625.1 EPA 8270D

Chlorinated Hydrocarbons

Hexachlorobutadiene	EPA 625.1 EPA 8270D
Hexachlorocyclopentadiene	EPA 625.1 EPA 8270D
Hexachloroethane	EPA 625.1 EPA 8270D
Pentachlorobenzene	EPA 8270D

Chlorophenoxy Acid Pesticides

2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A SM 6640B-2006
2,4-D	EPA 8151A
Dicamba	EPA 8151A

Demand

Biochemical Oxygen Demand	SM 5210B-2011
Carbonaceous BOD	SM 5210B-2011
Chemical Oxygen Demand	SM 5220D-2011

Fuel Oxygenates

Di-isopropyl ether	EPA 8260C
Ethanol	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-amyl alcohol	EPA 8260C
tert-amyl methyl ether (TAME)	EPA 8260C
tert-butyl alcohol	EPA 8260C

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Fuel Oxygenates

tert-butyl ethyl ether (ETBE)	EPA 8260C

Haloethers

2,2'-Oxybis(1-chloropropane)	EPA 625.1
	EPA 8270D
4-Bromophenylphenyl ether	EPA 625.1
	EPA 8270D
4-Chlorophenylphenyl ether	EPA 625.1
	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 625.1
	EPA 8270D
Bis(2-chloroethyl)ether	EPA 625.1
	EPA 8270D

Low Level Halocarbons

1,2,3-Trichloropropane, Low Level	EPA 8011
1,2-Dibromo-3-chloropropane, Low Level	EPA 8011
1,2-Dibromoethane, Low Level	EPA 8011

Low Level Polynuclear Aromatics

Acenaphthene Low Level	EPA 8270D
Acenaphthylene Low Level	EPA 8270D
Anthracene Low Level	EPA 8270D
Benzo(a)anthracene Low Level	EPA 8270D
Benzo(a)pyrene Low Level	EPA 8270D
Benzo(b)fluoranthene Low Level	EPA 8270D
Benzo(g,h,i)perylene Low Level	EPA 8270D

Low Level Polynuclear Aromatics

Benzo(k)fluoranthene Low Level	EPA 8270D
Chrysene Low Level	EPA 8270D
Dibenzo(a,h)anthracene Low Level	EPA 8270D
Fluoranthene Low Level	EPA 8270D
Fluorene Low Level	EPA 8270D
Indeno(1,2,3-cd)pyrene Low Level	EPA 8270D
Naphthalene Low Level	EPA 8270D
Phenanthrene Low Level	EPA 8270D
Pyrene Low Level	EPA 8270D

Metals I

Barium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Cadmium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Calcium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Metals I

Chromium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Copper, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Iron, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
Lead, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Magnesium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
Manganese, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C

Metals I

Manganese, Total	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Nickel, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Potassium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
Silver, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Sodium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D

Metals II

Aluminum, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C

Serial No.: 59448

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Metals II	
Aluminum, Total	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Antimony, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Arsenic, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Beryllium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Chromium VI	EPA 7196A
	SM 3500-Cr B-2011
Mercury, Total	EPA 245.1, Rev. 3.0 (1994)
	EPA 245.2 (Issued 1974, Rev. 1983)

Metals II	
Mercury, Total	EPA 7470A
	EPA 7473
Selenium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Vanadium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Zinc, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Metals III	
Cobalt, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Metals III

Cobalt, Total	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Molybdenum, Total	EPA 6020A
	EPA 200.8, Rev. 5.4 (1994)
Thallium, Total	EPA 200.7, Rev. 4.4 (1994)
	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
	EPA 200.8, Rev. 5.4 (1994)
Tin, Total	EPA 6020A
	EPA 200.8, Rev. 5.4 (1994)
Titanium, Total	EPA 6020A
	EPA 200.8, Rev. 5.4 (1994)

Mineral

Alkalinity	SM 2320B-2011
Calcium Hardness	EPA 200.7, Rev. 4.4 (1994)
Chloride	EPA 300.0, Rev. 2.1 (1993)
Fluoride, Total	EPA 300.0, Rev. 2.1 (1993)
Hardness, Total	EPA 200.7, Rev. 4.4 (1994)
Sulfate (as SO4)	EPA 300.0, Rev. 2.1 (1993)

Miscellaneous

Boron, Total	EPA 6020A
	EPA 200.8, Rev. 5.4 (1994)
Bromide	EPA 300.0, Rev. 2.1 (1993)

Miscellaneous

Color	SM 2120B-2011
Cyanide, Total	SM 4500-CN E-2011
Oil and Grease Total Recoverable (HEM)	EPA 1664A
Organic Carbon, Total	SM 5310C-2011
Phenols	EPA 420.1 (Rev. 1978)
Specific Conductance	EPA 120.1 (Rev. 1982)
Sulfide (as S)	SM 4500-S2- F-2011
Surfactant (MBAS)	SM 5540C-2011
Turbidity	EPA 180.1, Rev. 2.0 (1993)

Nitroaromatics and Isophorone

2,4-Dinitrotoluene	EPA 625.1
	EPA 8270D
2,6-Dinitrotoluene	EPA 625.1
	EPA 8270D
Isophorone	EPA 625.1
	EPA 8270D
Nitrobenzene	EPA 625.1
	EPA 8270D

Nitrosoamines

N-Nitrosodimethylamine	EPA 625.1
	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 625.1
	EPA 8270D
N-Nitrosodiphenylamine	EPA 625.1
	EPA 8270D

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NELAP RECOGNIZED ACCREDITATION BODY

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER All approved analytes are listed below:

Nutrient

Ammonia (as N)	SM 4500-NH3 D-2011 or E-2011
Kjeldahl Nitrogen, Total	SM 4500-N Org D-2011
	SM 4500-NH3 D-2011 or E-2011
Nitrate (as N)	EPA 300.0, Rev. 2.1 (1993)
Nitrate-Nitrite (as N)	EPA 300.0, Rev. 2.1 (1993)
Nitrite (as N)	EPA 300.0, Rev. 2.1 (1993)
Orthophosphate (as P)	EPA 300.0, Rev. 2.1 (1993)
	SM 4500-P E-2011
Phosphorus, Total	SM 4500-P E-2011

Organophosphate Pesticides

Atrazine	EPA 8270D
Parathion ethyl	EPA 8270D

Petroleum Hydrocarbons

Diesel Range Organics	EPA 8015D
Gasoline Range Organics	EPA 8015D

Phthalate Esters

Benzyl butyl phthalate	EPA 625.1
	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 625.1
	EPA 8270D
Diethyl phthalate	EPA 625.1
	EPA 8270D
Dimethyl phthalate	EPA 625.1
	EPA 8270D

Phthalate Esters

Di-n-butyl phthalate	EPA 625.1
	EPA 8270D
Di-n-octyl phthalate	EPA 625.1
	EPA 8270D

Polychlorinated Biphenyls

Aroclor 1016 (PCB-1016)	EPA 8082A
	EPA 608.3
Aroclor 1221 (PCB-1221)	EPA 8082A
	EPA 608.3
Aroclor 1232 (PCB-1232)	EPA 8082A
	EPA 608.3
Aroclor 1242 (PCB-1242)	EPA 8082A
	EPA 608.3
Aroclor 1248 (PCB-1248)	EPA 8082A
	EPA 608.3
Aroclor 1254 (PCB-1254)	EPA 8082A
	EPA 608.3
Aroclor 1260 (PCB-1260)	EPA 8082A
	EPA 608.3
Aroclor 1262 (PCB-1262)	EPA 8082A
Aroclor 1268 (PCB-1268)	EPA 8082A

Polynuclear Aromatics

Acenaphthene	EPA 625.1
	EPA 8270D
Acenaphthylene	EPA 625.1

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NELAP RECOGNIZED TNI ACCREDITATION BODY

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Polynuclear Aromatics

Acenaphthylene	EPA 8270D
Anthracene	EPA 625.1
	EPA 8270D
Benzo(a)anthracene	EPA 625.1
	EPA 8270D
Benzo(a)pyrene	EPA 625.1
	EPA 8270D
Benzo(b)fluoranthene	EPA 625.1
	EPA 8270D
Benzo(g,h,i)perylene	EPA 625.1
	EPA 8270D
Benzo(k)fluoranthene	EPA 625.1
	EPA 8270D
Chrysene	EPA 625.1
	EPA 8270D
Dibenzo(a,h)anthracene	EPA 625.1
	EPA 8270D
Fluoranthene	EPA 625.1
	EPA 8270D
Fluorene	EPA 625.1
	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 625.1
	EPA 8270D
Naphthalene	EPA 625.1
	EPA 8270D
Phenanthrene	EPA 625.1

Polynuclear Aromatics

Phenanthrene	EPA 8270D
Pyrene	EPA 625.1
	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 625.1
	EPA 8270D
2,4,6-Trichlorophenol	EPA 625.1
	EPA 8270D
2,4-Dichlorophenol	EPA 625.1
	EPA 8270D
2,4-Dimethylphenol	EPA 625.1
	EPA 8270D
2,4-Dinitrophenol	EPA 625.1
	EPA 8270D
2-Chlorophenol	EPA 625.1
	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 625.1
	EPA 8270D
2-Methylphenol	EPA 625.1
	EPA 8270D
2-Nitrophenol	EPA 625.1
	EPA 8270D
4-Chloro-3-methylphenol	EPA 625.1
	EPA 8270D

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Priority Pollutant Phenols

4-Methylphenol	EPA 625.1 EPA 8270D
4-Nitrophenol	EPA 625.1 EPA 8270D
Cresols, Total	EPA 8270D
Pentachlorophenol	EPA 625.1 EPA 8270D
Phenol	EPA 625.1 EPA 8270D

Residue

Settleable Solids	SM 2540 F-2011
Solids, Total	SM 2540 B-2011
Solids, Total Dissolved	SM 2540 C-2011
Solids, Total Suspended	SM 2540 D-2011

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
Acetophenone	EPA 8270D
alpha-Terpineol	EPA 625.1
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D

Semi-Volatile Organics

Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C EPA 624.1
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C EPA 624.1
1,4-Dichlorobenzene	EPA 8260C EPA 624.1
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C EPA 624.1
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 8260C EPA 624.1
Ethyl benzene	EPA 8260C EPA 624.1
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C EPA 624.1
Naphthalene, Volatile	EPA 8260C

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Volatile Aromatics

n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
	EPA 624.1
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
	EPA 624.1
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
	EPA 624.1
Total Xylenes	EPA 8260C
	EPA 624.1

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
	EPA 624.1
1,1,2,2-Tetrachloroethane	EPA 8260C
	EPA 624.1
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
	EPA 624.1
1,1-Dichloroethane	EPA 8260C
	EPA 624.1
1,1-Dichloroethene	EPA 8260C

Volatile Halocarbons

1,1-Dichloroethene	EPA 624.1
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C
	EPA 624.1
1,2-Dichloropropane	EPA 8260C
	EPA 624.1
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
	EPA 624.1
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
	EPA 624.1
Bromoform	EPA 8260C
	EPA 624.1
Bromomethane	EPA 8260C
	EPA 624.1
Carbon tetrachloride	EPA 8260C
	EPA 624.1
Chloroethane	EPA 8260C
	EPA 624.1
Chloroform	EPA 8260C
	EPA 624.1

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER All approved analytes are listed below:

Volatile Halocarbons

Chloromethane	EPA 8260C EPA 624.1
cis-1,2-Dichloroethene	EPA 8260C EPA 624.1
cis-1,3-Dichloropropene	EPA 8260C EPA 624.1
Dibromochloromethane	EPA 8260C EPA 624.1
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C EPA 624.1
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 8260C EPA 624.1
Tetrachloroethene	EPA 8260C EPA 624.1
trans-1,2-Dichloroethene	EPA 8260C EPA 624.1
trans-1,3-Dichloropropene	EPA 8260C EPA 624.1
trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 8260C EPA 624.1
Trichlorofluoromethane	EPA 8260C EPA 624.1
Vinyl chloride	EPA 8260C

Volatile Halocarbons

Vinyl chloride	EPA 624.1

Volatiles Organics

1,4-Dioxane	EPA 8260C EPA 8270D SIM
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Vinyl acetate	EPA 8260C

Sample Preparation Methods

SM 4500-P B(5)-2011
EPA 5030C
SM 4500-CN B-2011 and C-201
EPA 3015A
EPA 3010A
EPA 3005A
EPA 3510C
SM 4500-N Org B-2011 or C-20

Serial No.: 59448

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NELAP RECOGNIZED ACCREDITATION BODY

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 8260C
Acrylonitrile	EPA 8260C
Methyl methacrylate	EPA 8260C

Amines

1,2-Diphenylhydrazine	EPA 8270D
2-Nitroaniline	EPA 8270D
3-Nitroaniline	EPA 8270D
4-Chloroaniline	EPA 8270D
4-Nitroaniline	EPA 8270D
Aniline	EPA 8270D
Carbazole	EPA 8270D
Diphenylamine	EPA 8270D

Benzidines

3,3'-Dichlorobenzidine	EPA 8270D
Benzidine	EPA 8270D

Characteristic Testing

Corrosivity	EPA 9045D
Free Liquids	EPA 9095B
Ignitability	EPA 1010A
Synthetic Precipitation Leaching Proc.	EPA 1312
TCLP	EPA 1311

Chlorinated Hydrocarbon Pesticides

4,4'-DDD	EPA 8081B
4,4'-DDE	EPA 8081B

Chlorinated Hydrocarbon Pesticides

4,4'-DDT	EPA 8081B
Aldrin	EPA 8081B
alpha-BHC	EPA 8081B
alpha-Chlordane	EPA 8081B
Atrazine	EPA 8270D
beta-BHC	EPA 8081B
Chlordane Total	EPA 8081B
delta-BHC	EPA 8081B
Dieldrin	EPA 8081B
Endosulfan I	EPA 8081B
Endosulfan II	EPA 8081B
Endosulfan sulfate	EPA 8081B
Endrin	EPA 8081B
Endrin aldehyde	EPA 8081B
Endrin Ketone	EPA 8081B
gamma-Chlordane	EPA 8081B
Heptachlor	EPA 8081B
Heptachlor epoxide	EPA 8081B
Lindane	EPA 8081B
Methoxychlor	EPA 8081B
Mirex	EPA 8081B
Toxaphene	EPA 8081B

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C
1,2,4,5-Tetrachlorobenzene	EPA 8270D

Serial No.: 59449

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NELAP RECOGNIZED
ACCREDITATION BODY

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Chlorinated Hydrocarbons	
1,2,4-Trichlorobenzene	EPA 8270D
2-Chloronaphthalene	EPA 8270D
Hexachlorobenzene	EPA 8270D
Hexachlorobutadiene	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D
Hexachloroethane	EPA 8270D
Chlorophenoxy Acid Pesticides	
2,4,5-T	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A
2,4-D	EPA 8151A
Dicamba	EPA 8151A
Haloethers	
2,2'-Oxybis(1-chloropropane)	EPA 8270D
4-Bromophenylphenyl ether	EPA 8270D
4-Chlorophenylphenyl ether	EPA 8270D
Bis(2-chloroethoxy)methane	EPA 8270D
Bis(2-chloroethyl)ether	EPA 8270D
Metals I	
Barium, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Cadmium, Total	EPA 6010C
	EPA 6010D

Metals I	
Cadmium, Total	EPA 6020A
	EPA 6020B
Calcium, Total	EPA 6010C
	EPA 6010D
Chromium, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Copper, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Iron, Total	EPA 6010C
	EPA 6010D
Lead, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Magnesium, Total	EPA 6010C
	EPA 6010D
Manganese, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Nickel, Total	EPA 6010C
	EPA 6010D

Serial No.: 59449

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Metals I

Nickel, Total	EPA 6020A
	EPA 6020B
Potassium, Total	EPA 6010C
	EPA 6010D
Silver, Total	EPA 6010C
	EPA 6010D
Sodium, Total	EPA 6010C
	EPA 6010D

Metals II

Aluminum, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Antimony, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Arsenic, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Beryllium, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B

Metals II

Chromium VI	EPA 7196A
Mercury, Total	EPA 7471B
	EPA 7473
Selenium, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Vanadium, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Zinc, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B

Metals III

Cobalt, Total	EPA 6010C
	EPA 6010D
	EPA 6020A
	EPA 6020B
Molybdenum, Total	EPA 6010D
	EPA 6020A
Thallium, Total	EPA 6010C
	EPA 6010D
	EPA 6020A

Serial No.: 59449

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Metals III	
Thallium, Total	EPA 6020B
Tin, Total	EPA 6020A
	EPA 6020B
Titanium, Total	EPA 6020A
Miscellaneous	
Boron, Total	EPA 6020A
	EPA 6020B
Cyanide, Total	EPA 9014
Extractable Organic Halides	EPA 9023
Lead in Dust Wipes	EPA 6010C
Lead in Paint	EPA 6010C
Nitroaromatics and Isophorone	
2,4-Dinitrotoluene	EPA 8270D
2,6-Dinitrotoluene	EPA 8270D
Isophorone	EPA 8270D
Nitrobenzene	EPA 8270D
Pyridine	EPA 8270D
Nitrosoamines	
N-Nitrosodimethylamine	EPA 8270D
N-Nitrosodi-n-propylamine	EPA 8270D
N-Nitrosodiphenylamine	EPA 8270D
Organophosphate Pesticides	
Parathion ethyl	EPA 8270D

Petroleum Hydrocarbons	
Diesel Range Organics	EPA 8015D
Gasoline Range Organics	EPA 8015D
Phthalate Esters	
Benzyl butyl phthalate	EPA 8270D
Bis(2-ethylhexyl) phthalate	EPA 8270D
Diethyl phthalate	EPA 8270D
Dimethyl phthalate	EPA 8270D
Di-n-butyl phthalate	EPA 8270D
Di-n-octyl phthalate	EPA 8270D
Polychlorinated Biphenyls	
Aroclor 1016 (PCB-1016)	EPA 8082A
Aroclor 1016 (PCB-1016) in Oil	EPA 8082A
Aroclor 1221 (PCB-1221)	EPA 8082A
Aroclor 1221 (PCB-1221) in Oil	EPA 8082A
Aroclor 1232 (PCB-1232)	EPA 8082A
Aroclor 1232 (PCB-1232) in Oil	EPA 8082A
Aroclor 1242 (PCB-1242)	EPA 8082A
Aroclor 1242 (PCB-1242) in Oil	EPA 8082A
Aroclor 1248 (PCB-1248)	EPA 8082A
Aroclor 1248 (PCB-1248) in Oil	EPA 8082A
Aroclor 1254 (PCB-1254)	EPA 8082A
Aroclor 1254 (PCB-1254) in Oil	EPA 8082A
Aroclor 1260 (PCB-1260)	EPA 8082A
Aroclor 1260 (PCB-1260) in Oil	EPA 8082A
Aroclor 1262 (PCB-1262)	EPA 8082A

Serial No.: 59449

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Polychlorinated Biphenyls

Aroclor 1262 (PCB-1262) in Oil	EPA 8082A
Aroclor 1268 (PCB-1268)	EPA 8082A
Aroclor 1268 (PCB-1268) in Oil	EPA 8082A

Polynuclear Aromatic Hydrocarbons

Acenaphthene	EPA 8270D
Acenaphthylene	EPA 8270D
Anthracene	EPA 8270D
Benzo(a)anthracene	EPA 8270D
Benzo(a)pyrene	EPA 8270D
Benzo(b)fluoranthene	EPA 8270D
Benzo(g,h,i)perylene	EPA 8270D
Benzo(k)fluoranthene	EPA 8270D
Chrysene	EPA 8270D
Dibenzo(a,h)anthracene	EPA 8270D
Fluoranthene	EPA 8270D
Fluorene	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D
Naphthalene	EPA 8270D
Phenanthrene	EPA 8270D
Pyrene	EPA 8270D

Priority Pollutant Phenols

2,3,4,6 Tetrachlorophenol	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D
2,4-Dichlorophenol	EPA 8270D

Priority Pollutant Phenols

2,4-Dimethylphenol	EPA 8270D
2,4-Dinitrophenol	EPA 8270D
2-Chlorophenol	EPA 8270D
2-Methyl-4,6-dinitrophenol	EPA 8270D
2-Methylphenol	EPA 8270D
2-Nitrophenol	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D
4-Methylphenol	EPA 8270D
4-Nitrophenol	EPA 8270D
Pentachlorophenol	EPA 8270D
Phenol	EPA 8270D

Semi-Volatile Organics

1,1'-Biphenyl	EPA 8270D
1,2-Dichlorobenzene, Semi-volatile	EPA 8270D
1,3-Dichlorobenzene, Semi-volatile	EPA 8270D
1,4-Dichlorobenzene, Semi-volatile	EPA 8270D
2-Methylnaphthalene	EPA 8270D
Acetophenone	EPA 8270D
Benzaldehyde	EPA 8270D
Benzoic Acid	EPA 8270D
Benzyl alcohol	EPA 8270D
Caprolactam	EPA 8270D
Dibenzofuran	EPA 8270D

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C

Serial No.: 59449

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Volatile Aromatics

1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
1,4-Dichlorobenzene	EPA 8260C
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 8260C
Ethyl benzene	EPA 8260C
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
Total Xylenes	EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
1,1-Dichloroethane	EPA 8260C
1,1-Dichloroethene	EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
Bromoform	EPA 8260C
Bromomethane	EPA 8260C
Carbon tetrachloride	EPA 8260C
Chloroethane	EPA 8260C
Chloroform	EPA 8260C
Chloromethane	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C
Dibromochloromethane	EPA 8260C

Serial No.: 59449

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MR. ROBERT Q. BRADLEY
YORK ANALYTICAL LABORATORIES INC
120 RESEARCH DRIVE
STRATFORD, CT 06615

NY Lab Id No: 10854

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE All approved analytes are listed below:

Volatile Halocarbons

Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 8260C
Tetrachloroethene	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C
Trichloroethene	EPA 8260C
Trichlorofluoromethane	EPA 8260C
Vinyl chloride	EPA 8260C

Volatile Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-butyl alcohol	EPA 8260C
Vinyl acetate	EPA 8260C

Sample Preparation Methods

EPA 5035A-L

Sample Preparation Methods

EPA 5035A-H
EPA 3580A
EPA 3010A
EPA 3050B
EPA 3550C
EPA 3546
EPA 3545A
EPA 3060A
EPA 9010C

Serial No.: 59449

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MICHELLE FREEMAN
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES POTABLE WATER
All approved analytes are listed below:

Perfluorinated Alkyl Acids

Perfluorooctanesulfonic acid (PFOS)	EPA 537
Perfluorooctanoic acid (PFOA)	EPA 537

Serial No.: 60019

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MICHELLE FREEMAN
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 8260C
Acrylonitrile	EPA 8260C
Methyl methacrylate	EPA 8260C

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C

Fuel Oxygenates

Di-isopropyl ether	EPA 8260C
Ethanol	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-amyl alcohol	EPA 8260C
tert-amyl methyl ether (TAME)	EPA 8260C
tert-butyl alcohol	EPA 8260C
tert-butyl ethyl ether (ETBE)	EPA 8260C

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
1,4-Dichlorobenzene	EPA 8260C
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
Bromobenzene	EPA 8260C

Volatile Aromatics

Chlorobenzene	EPA 8260C
Ethyl benzene	EPA 8260C
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C
sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
Total Xylenes	EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
1,1-Dichloroethane	EPA 8260C
1,1-Dichloroethene	EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C

Serial No.: 60020

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MICHELLE FREEMAN
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER
All approved analytes are listed below:

Volatile Halocarbons

1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
Bromoform	EPA 8260C
Bromomethane	EPA 8260C
Carbon tetrachloride	EPA 8260C
Chloroethane	EPA 8260C
Chloroform	EPA 8260C
Chloromethane	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C
Dibromochloromethane	EPA 8260C
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 8260C
Tetrachloroethene	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C
trans-1,4-Dichloro-2-butene	EPA 8260C
Trichloroethene	EPA 8260C

Volatile Halocarbons

Trichlorofluoromethane	EPA 8260C
Vinyl chloride	EPA 8260C

Volatiles Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Carbon Disulfide	EPA 8260C
Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Vinyl acetate	EPA 8260C

Sample Preparation Methods

	EPA 5030C

Serial No.: 60020

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MICHELLE FREEMAN
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Acrylates

Acrolein (Propenal)	EPA 8260C
Acrylonitrile	EPA 8260C
Methyl methacrylate	EPA 8260C

Chlorinated Hydrocarbons

1,2,3-Trichlorobenzene	EPA 8260C

Volatile Aromatics

1,2,4-Trichlorobenzene, Volatile	EPA 8260C
1,2,4-Trimethylbenzene	EPA 8260C
1,2-Dichlorobenzene	EPA 8260C
1,3,5-Trimethylbenzene	EPA 8260C
1,3-Dichlorobenzene	EPA 8260C
1,4-Dichlorobenzene	EPA 8260C
2-Chlorotoluene	EPA 8260C
4-Chlorotoluene	EPA 8260C
Benzene	EPA 8260C
Bromobenzene	EPA 8260C
Chlorobenzene	EPA 8260C
Ethyl benzene	EPA 8260C
Isopropylbenzene	EPA 8260C
m/p-Xylenes	EPA 8260C
Naphthalene, Volatile	EPA 8260C
n-Butylbenzene	EPA 8260C
n-Propylbenzene	EPA 8260C
o-Xylene	EPA 8260C
p-Isopropyltoluene (P-Cymene)	EPA 8260C

Volatile Aromatics

sec-Butylbenzene	EPA 8260C
Styrene	EPA 8260C
tert-Butylbenzene	EPA 8260C
Toluene	EPA 8260C
Total Xylenes	EPA 8260C

Volatile Halocarbons

1,1,1,2-Tetrachloroethane	EPA 8260C
1,1,1-Trichloroethane	EPA 8260C
1,1,2,2-Tetrachloroethane	EPA 8260C
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA 8260C
1,1,2-Trichloroethane	EPA 8260C
1,1-Dichloroethane	EPA 8260C
1,1-Dichloroethene	EPA 8260C
1,1-Dichloropropene	EPA 8260C
1,2,3-Trichloropropane	EPA 8260C
1,2-Dibromo-3-chloropropane	EPA 8260C
1,2-Dibromoethane	EPA 8260C
1,2-Dichloroethane	EPA 8260C
1,2-Dichloropropane	EPA 8260C
1,3-Dichloropropane	EPA 8260C
2,2-Dichloropropane	EPA 8260C
2-Chloroethylvinyl ether	EPA 8260C
Bromochloromethane	EPA 8260C
Bromodichloromethane	EPA 8260C
Bromoform	EPA 8260C

Serial No.: 60021

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MICHELLE FREEMAN
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category
ENVIRONMENTAL ANALYSES SOLID AND HAZARDOUS WASTE
All approved analytes are listed below:

Volatile Halocarbons

Bromomethane	EPA 8260C
Carbon tetrachloride	EPA 8260C
Chloroethane	EPA 8260C
Chloroform	EPA 8260C
Chloromethane	EPA 8260C
cis-1,2-Dichloroethene	EPA 8260C
cis-1,3-Dichloropropene	EPA 8260C
Dibromochloromethane	EPA 8260C
Dibromomethane	EPA 8260C
Dichlorodifluoromethane	EPA 8260C
Hexachlorobutadiene, Volatile	EPA 8260C
Methylene chloride	EPA 8260C
Tetrachloroethene	EPA 8260C
trans-1,2-Dichloroethene	EPA 8260C
trans-1,3-Dichloropropene	EPA 8260C
Trichloroethene	EPA 8260C
Trichlorofluoromethane	EPA 8260C
Vinyl chloride	EPA 8260C

Volatile Organics

1,4-Dioxane	EPA 8260C
2-Butanone (Methylethyl ketone)	EPA 8260C
2-Hexanone	EPA 8260C
4-Methyl-2-Pentanone	EPA 8260C
Acetone	EPA 8260C
Carbon Disulfide	EPA 8260C

Volatile Organics

Cyclohexane	EPA 8260C
Methyl acetate	EPA 8260C
Methyl cyclohexane	EPA 8260C
Methyl tert-butyl ether	EPA 8260C
tert-butyl alcohol	EPA 8260C
Vinyl acetate	EPA 8260C

Sample Preparation Methods

EPA 5035A-L
EPA 5035A-H

Serial No.: 60021

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MICHELLE FREEMAN
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES AIR AND EMISSIONS All approved analytes are listed below:

Acrylates

Acrylonitrile	EPA TO-15
Methyl methacrylate	EPA TO-15

Chlorinated Hydrocarbons

1,2,4-Trichlorobenzene	EPA TO-15
Hexachlorobutadiene	EPA TO-15
Hexachloroethane	EPA TO-15

Purgeable Aromatics

1,2,4-Trimethylbenzene	EPA TO-15
1,2-Dichlorobenzene	EPA TO-15
1,3,5-Trimethylbenzene	EPA TO-15
1,3-Dichlorobenzene	EPA TO-15
1,4-Dichlorobenzene	EPA TO-15
Benzene	EPA TO-15
Chlorobenzene	EPA TO-15
Ethyl benzene	EPA TO-15
Isopropylbenzene	EPA TO-15
m/p-Xylenes	EPA TO-15
o-Xylene	EPA TO-15
Styrene	EPA TO-15
Toluene	EPA TO-15
Total Xylenes	EPA TO-15

Purgeable Halocarbons

1,1,1-Trichloroethane	EPA TO-15
1,1,2,2-Tetrachloroethane	EPA TO-15

Purgeable Halocarbons

1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA TO-15
1,1,2-Trichloroethane	EPA TO-15
1,1-Dichloroethane	EPA TO-15
1,1-Dichloroethene	EPA TO-15
1,2-Dibromoethane	EPA TO-15
1,2-Dichloroethane	EPA TO-15
1,2-Dichloropropane	EPA TO-15
3-Chloropropene (Allyl chloride)	EPA TO-15
Bromodichloromethane	EPA TO-15
Bromoform	EPA TO-15
Bromomethane	EPA TO-15
Carbon tetrachloride	EPA TO-15
Chloroethane	EPA TO-15
Chloroform	EPA TO-15
Chloromethane	EPA TO-15
cis-1,2-Dichloroethene	EPA TO-15
cis-1,3-Dichloropropene	EPA TO-15
Dibromochloromethane	EPA TO-15
Dichlorodifluoromethane	EPA TO-15
Methylene chloride	EPA TO-15
Tetrachloroethene	EPA TO-15
trans-1,2-Dichloroethene	EPA TO-15
trans-1,3-Dichloropropene	EPA TO-15
Trichloroethene	EPA TO-15
Trichlorofluoromethane	EPA TO-15
Vinyl bromide	EPA TO-15

Serial No.: 60022

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER

Expires 12:01 AM April 01, 2020
Issued April 01, 2019

CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

Issued in accordance with and pursuant to section 502 Public Health Law of New York State

MS. MICHELLE FREEMAN
YORK ANALYTICAL LABORATORIES, INC. (II)
132-02 89TH AVENUE SUITE 217
RICHMOND HILL, NY 11418

NY Lab Id No: 12058

is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES AIR AND EMISSIONS
All approved analytes are listed below:

Purgeable Halocarbons	
Vinyl chloride	EPA TO-15
Volatile Chlorinated Organics	
Benzyl chloride	EPA TO-15
Volatile Organics	
1,2-Dichlorotetrafluoroethane	EPA TO-15
1,3-Butadiene	EPA TO-15
1,4-Dioxane	EPA TO-15
2-Butanone (Methylethyl ketone)	EPA TO-15
4-Methyl-2-Pentanone	EPA TO-15
Acetone	EPA TO-15
Carbon Disulfide	EPA TO-15
Cyclohexane	EPA TO-15
Hexane	EPA TO-15
Isopropanol	EPA TO-15
Methyl tert-butyl ether	EPA TO-15
n-Heptane	EPA TO-15
Vinyl acetate	EPA TO-15

Serial No.: 60022

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.