ROUX

Remedial Investigation Work Plan/Interim Remedial Measures Work Plan

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5000 1st Avenue
Brooklyn, New York

October 1, 2021

Prepared for:

Steiner Sequel, LLC
15 Washington Avenue
Brooklyn, New York 11205

Prepared by:

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Certification

I, Charles J. McGuckin, P.E., certify that I am currently a NYS registered professional engineer and that this Remedial Investigation Work Plan/Interim Remedial Measure (RIWP/IRMWP) Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and the BCP Agreement for the Site.

I certify that all information and statements in this certification are true. I understand that a false statement made herein is punishable as Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

Charles J. McGuckin, P.E. 10/1/2021 Charles McGuckin
NYS Professional Engineer # Date Signature

CHARLES J. MCGUCKIN
069509

It is a violation of Article 130 of New York State Education Law for any person to alter this document in any way without the express written verification of adoption by any New York State licensed engineer in accordance with Section 7209(2), Article 145, New York State Education Law.

I, Frank Cherena, certify that I am currently a Qualified Environmental Professional as defined in 6 New York Codes, Rules and Regulation (NYCRR) Part 375 and that this Remedial Investigation Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 (DER-10).

Frank Cherena 10/1/2021 Frank Cherena
Qualified Environmental Professional Date Signature

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Environmental Consultant), on behalf of Steiner Sequel LLC (Applicant), has prepared this Remedial Investigation Work Plan/Interim Remedial Measures Work Plan (RIWP/IRMWP) for the property located at 5000 1st Avenue, Brooklyn, New York (Site), as shown on Figure 1. The Site is approximately 13.743 acres and is comprised of Tax Block 725, and p/o Lots 1 and 100 of the New York City (NYC) Tax Map, as shown on Figure 2. The Site is currently owned by The City of New York and the proposed Applicant has entered into a lease agreement which allows for full access to complete Site investigation, remediation, and redevelopment. The planned redevelopment of the Site includes a new approximately 900,000 gross square foot film and television production and support space. The redevelopment will include eight soundstages, two outdoor green screens, onsite lighting and grip equipment rental, and product support spaces what include mill shops for set construction, scenic artist workshops, props and set dressing spaces, wardrobe departments, dressing rooms, hair and makeup rooms, commissaries, and office space. Additionally, a new parking structure will be constructed that will provide parking for approximately 570 vehicles.

This RIWP/IRMWP has been submitted by the Applicant concurrently with the New York State Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) application. The RIWP portion of this work plan is intended to satisfy NYSDEC BCP requirements to delineate the nature and extent of contamination and allow for effective evaluation of multiple BCP cleanup track alternatives. The IRMWP portion of this work plan includes the demolition of one of the existing structures at the Site, designated as unit G, to facilitate the investigation of the impacts to soil, groundwater, and soil vapor and begin the removal of documented soil contamination. This will further facilitate the selection and implementation of the final remedy.

This RIWP/IRMWP has been prepared in accordance with NYSDEC procedures set forth in the document titled DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 (DER-10), and complies with all applicable Federal, State, and local laws, regulations, and requirements. The RI/IRM is a component of, and will facilitate, but does not constitute, the overall remedy for the Site. The objectives of the RI/IRM are to remove existing structures to allow for a thorough and complete investigation of the Site and source area excavation of contaminated soil. This will advance the BCP goals but will not constitute the entire remedy for the Site.

The remainder of this RIWP/IRMWP is organized as follows:

Section 2: Site Background
Section 3: Objectives, Rationale, and Scope of Work
Section 4: Elements of the Interim Remedial Measure
Section 5: Soils/Materials Management Plan
Section 6: Reporting and Schedule

2. Site Background

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

2.1 Site Description and Setting

A Site Location Map and Tax Map are included as Figures 1 and 2, respectively.

Property Location	
Property Name:	Steiner Sequel
Property Address:	5000 1st Avenue
Property Town, County, State:	Brooklyn, Kings County, New York
Property Tax Identification:	Block 725, and p/o Lots 1 and 100
Property Topographic Quadrangle:	USGS-Brooklyn, New York
Nearest Intersection:	1st Avenue and 51st Street to the south and 1st Avenue and 43rd Street to the north. The following streets all intersect with 1st Avenue to the east: 44th Street, 47th Street, 48th Street, 49th Street, and 50th Street.
Area Description:	The southern portion of the Site on Lot 1 has two six-story buildings identified as buildings 57 and 58 and one seven-story building identified as unit G. The north portion of Lot 1 formerly contained buildings 39, 40, and 45 all of which were demolished in 2015. The remainder of the portion of the Site on Lot 1 is vacant or an asphalt parking lot. The portion of the Site on Lot 100 consists of an asphalt parking lot and two rail crossings at the Site entrance on 1st Avenue.

Property Information	
Property Size:	Approximately 13.743 acres
Property Use:	Building 57 is currently leased by various tenants for a variety of uses such as food wholesale distributor, clothing and textile manufacturer and distributor, a vending machine and food distributor, a clothing wholesale distributor, a plastic-goods wholesale distributor, a mattress wholesale distributor, a T-shirt printing and embroidery company, and a home goods distributor. Building 58 is also leased out for a variety of uses such as a restaurant supply and food distributor, a woodworking/carpentry company, a furniture wholesale distributor, a textile company, and a clothing distribution company. Unit G is currently vacant.
Improvements:	Buildings 57 and 58, and unit G remain onsite.

2.1.1 Site Operations

Based on Historic Sanborn fire insurance maps (Sanborn maps), in the late 1880s, the Site was mostly vacant while the northern portion of the Site was developed with a residential dwelling and a shed. By 1906, the Site was occupied by warehouse buildings: one seven-story structure (present day unit G designated as warehouse #51-56), two six story structures (warehouse #45-50 and #39-44) located north of unit G, a 100,000-gallon water tank, and rail lines. Additionally, a rail yard made up the majority of the east side of the Site with rail lines branching off and running in an east-west direction from the rail yard to the shipping piers located outside of the Site, along the western border extending out into the Bay Ridge Channel. By 1922, present day buildings 57 and 58 had been constructed in the southern portion of the Site, and a one-story irregularly shaped structure was constructed between building 57 and unit G. Additional rail lines extending out to the piers toward the west are present on the 1922 Sanborn map. The 1926 Sanborn map shows a building extension south of unit G is the location of a “refrigerating building”. The 1951 Sanborn map shows building 58 occupied by a tin manufacturer, building 57 occupied by a packaging company and a coffee roaster, and unit G and the adjacent two six-story structures (#45-50 and #39-44) operated as public warehouses.

The 1965 Sanborn map depicted that two six-story structures adjacent to unit G had been demolished and that a portion of building 45 had been constructed with a two-story garage, and buildings 40 and 30 were constructed. The 1965 Sanborn map also depicted that building 58 was occupied at the time by a paper warehouse and building 57 and unit G was occupied by Van Brunt Stores, Inc. The 1978 Sanborn showed the remainder of building 45 as constructed into its most recent configuration prior to demolition in 2015. The designated year of construction shown on the Sanborn is 1970. According to the Phase I Environmental Site Assessment prepared by TRC Engineers, Inc., dated December 17, 2019 (Phase I ESA) Buildings 39, 40, and 45 were demolished in 2015.

A map showing an aerial view of the existing conditions is provided as Figure 3.

2.1.2 Neighboring Properties

The Site is bounded by the following properties, as summarized in the table below. Adjacent property owners are shown on Figure 4.

Adjacent Property Direction	Property Use
North	A healthcare product and equipment distribution center, lighting fixture showroom, and the Bush Terminal Piers Park parking lot.
South	Brooklyn Sanitation Department.
East	A railyard directly adjacent to the Site and industrial use properties including manufacturing and product distribution, a garbage collection company, a storage facility, and a contractor storage yard across 1st Avenue.
West	Bush Terminal Piers Park

2.1.3 Topography/Hydrogeology

Based on a Site survey completed by Gallas Surveying Group, dated March 2021, included as part of Figure 5, the Site elevation ranges from approximately 16 feet North American Vertical Datum of 1988 (ft

NAVD88) along the eastern side of the Site closest to 1st Avenue to approximately 7 ft NAVD88 along the western side of the Site, closer to the Bay Ridge Channel which at the closest portions is located approximately 60 feet west of the Site.

Based on the 2020 TRC Engineers, Inc. (TRC) Phase II Environmental Site Investigation (ESI) Report, the Site is underlain by a layer of historic fill of varying thickness to depths ranging from approximately 1.5 to 20 feet below land surface (ft bls). Encountered historic fill materials included manufactured aggregates, bricks, concrete, asphalt, and wood. Native soil underlying historic fill consisted of brown fine to coarse sand and silt with trace clay and gravel. Fill having staining, odor, and elevated photoionization detector (PID) values was observed at two soil borings completed in the northeastern corner of the Site. Depth to groundwater follows the surface topography and was observed at a depth ranging from 5.69 (west side of Site closer to Bay Ridge Channel) to 11.45 ft bls (on the eastern border of the Site).

Groundwater flow direction is likely influenced by tides, subsurface utilities, bedrock topography, and other subsurface features, however, is generally expected to flow in a westward direction, toward the Bay Ridge Channel.

2.2 Results of Previous Environmental Investigations

This section provides a summary of the data presented in the previously completed environmental investigation reports at the Site. The following environmental reports were available and were reviewed in preparation of this RIWP/IRMWP:

- Remedial Investigation Report (RIR), prepared by G.C. Environmental, Inc. (GCE), dated November 25, 2013;
- Phase I Environmental Site Assessment (ESA), prepared by TRC Engineers, Inc., dated December 17, 2019;
- Phase II ESI Report, prepared by TRC Engineers, Inc., dated May 2020; and
- Supplemental Phase II ESI Summary Report, prepared by TRC Engineers, Inc., dated October 6, 2020.

The findings of the reports are summarized below, and copies of the reports are provided in Appendix A. The proposed Site redevelopment plan is considered an industrial use with the proposed construction of a new approximately 900,000 gross square foot film and television production, set construction, and support space. Therefore, the soil data from the previous investigations was compared to New York State Department of Environmental Conservation (NYSDEC) Industrial Use Soil Cleanup Objectives (IUSCOs). All analytical data will also be compared to Unrestricted Use SCOs (UUSCOs) and Protection of Groundwater SCOs (PGWSCOs) in order to develop an appropriate remedial strategy. A summary of all soil concentrations exceeding the aforementioned SCOs is included on Figure 6, a summary of all groundwater concentrations exceeding the NYSDEC Ambient Water Quality Standards and Guidance Values (AWQSGVs) is included on Figure 7, and all soil vapor detections are summarized on Figure 8.

2.2.1 Remedial Investigation Report, prepared by GCE, dated November 25, 2013

GCE completed an RI in 2013 (2013 RI) that focused only on the area of former buildings 39, 40, and 45 in preparation for onsite construction in this area. The 2013 RI was not completed as part of a city or state regulatory requirement and the Site was not enrolled in a regulatory program. Buildings 39, 40, and 45 were demolished in 2015 and the planned construction was never completed.

Soil

A total of 39 soil samples were collected from 19 soil borings as part of the 2013 RI and analyzed for Target Compound List (TCL) VOCs + tentatively identified compounds (TICs), TCL SVOCs + TICs, TCL pesticides, PCBs, and Target Analyte List (TAL) metals. Laboratory results were compared to UUSCOs, PGWSCOs, and IUSCOs. Soil analytical data from this investigation only yielded exceedances of UUSCOs. Eleven soil samples exceeded UUSCOs and exceedances were limited to metals, PCBs, and pesticides. There were no exceedances of PGWSCOs and IUSCOs during the 2013 RI.

Groundwater

Ten groundwater samples (including one duplicate sample) were collected from 9 temporary monitoring wells and analyzed for the same suite of analysis as described above in the soil results section as part of the 2013 RI. Groundwater samples were analyzed for dissolved metals only and were filtered at the laboratory. Groundwater concentrations of PAHs, dissolved metals, and pesticides exceeded the NYSDEC AWQSGVs. There were no exceedances of AWQSGVs for VOCs or PCBs during the 2013 RI. Additional information on groundwater exceedances is provided below:

- Groundwater samples from MW-1, MW-2, MW-4, MW-6, MW-7, MW-8, and MW-9 had detections of PAHs at concentrations above AWQSGVs for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and/or indeno(1,2,3-cd)pyrene.
- As part of the 2013 RI, each of the 10 groundwater samples collected had detections of metals above AWQSGVs. The exceedances for dissolved metals included antimony, iron, lead, magnesium, manganese, and sodium.
- The groundwater sample collected from MW-7 yielded the only exceedance of AWQSGVs for pesticides. Dieldrin was detected at MW-7 which was located in the western portion of former building 45.

Soil Vapor

Four soil vapor samples, three sub-slab samples, and one outdoor ambient air sample was collected as part of the 2013 RI. Soil vapor samples were collected from approximately 5 ft bls and one sub-slab sample was collected from each of the three buildings (buildings 39, 40, and 45) and was collected from approximately 2-inches below the building's slab. The Environmental Consultant completed an evaluation of the soil vapor data collected as part of the 2013 RI and compared to the NYSDOH October 2006 Guidance for Evaluating Soil Vapor Intrusion (NYSDOH SVI Guidance), as amended.

The highest concentration of total petroleum-related VOCs in a soil vapor sample collected as part of the 2013 RI were detected at SV-2. SV-2 was located north of former building 45 adjacent to the location of closed spill #1306670 and subsurface anomalies identified during the RI. Benzene was detected at 37.7 ug/m^3, toluene was detected at 190 ug/m^3, ethylbenzene was detected at 127 ug/m^3, o-xylene was detected at 139 ug/m^3, and m,p-xylene was detected at 159 ug/m^3. Currently, there are no soil vapor standards or guidance values for these compounds set by NYSDEC or New York State Department of Health (NYSDOH).

CVOCs were also detected at elevated concentrations at the Site. The NYSDOH SVI Guidance provides three matrices with guidance values for sub-slab and indoor air comparison for eight CVOCs. The concentrations considered in the matrix are intended for the comparison of sub-slab vapor concentrations from beneath an existing building and indoor air within the building. Since indoor air samples were not collected as part of the 2013 RI, a direct comparison cannot be made, however, the matrices can still be used as an evaluation for the presence of these compounds in soil vapor. The concentrations of CVOC detections are summarized below:

Matrix A Compounds: carbon tetrachloride, cis-1,2-dichloroethene, 1,1-dichloroethene, trichloroethene (TCE)

- Maximum concentration of carbon tetrachloride was detected at sub-slab sample SSV-1 at 1.19 ug/m3.
- Maximum concentration of TCE was detected at soil vapor sample SV-2 at 607 ug/m3.
- Cis-1,2-dichloroethene and 1,1-dichloroethene were not detected in soil vapor.

Matrix B Compounds: tetrachloroethene (PCE), 1,1,1-trichloroethane, methylene chloride

- Maximum concentration of PCE was detected at soil vapor sample SV-3 at 350 ug/m3.
- Maximum concentration of methylene chloride was detected at sub-slab sample SSV-1 at 62.8 ug/m3.
- 1,1,1-trichloroethane was not detected in soil vapor.

Matrix C Compound: vinyl chloride

- Vinyl chloride was not detected in soil vapor.

2.2.2 Phase I ESA prepared by TRC, dated December 17, 2019

The Phase I ESA identified the following Recognized Environmental Conditions (RECs):

- Historic fill due to the proximity to the Bay Ridge Channel, methane gas due to potential organic rich deposits from historic filling of wetlands, and fill materials and suspect buried structures from demolition of former buildings.
- Rail lines were observed to run in a north-south direction during Site reconnaissance on the eastern portion of the Site. This observation was corroborated through the review of Sanborn Fire Maps which indicate rail lines were present since at least 1906.
- Historic use of the Site includes various manufacturers, a rail yard, a port terminal, a contractor yard, and a trucking company.
- Four onsite monitoring wells were identified behind unit G and along the property fence.
- On March 6, 2019, two transformers were removed in the area of former buildings 39, 40, and 45 by Innovative Recycling Technologies (IRT), a subcontractor of TRC. Concrete and surficial soil samples collected in the proximity of the transformers yielded PCB analytical results above the UUSCOs.
- A RIR, dated November 25, 2013, was prepared by GCE (2013 RI), and summarized the investigation completed in the area of buildings 39, 40, and 45 prior to building demolition. Analytical results yielded soil results above UUSCOs, groundwater results above AWQSGVs, and soil vapor concentrations above the NYSDOH Air Guidance Values.
- The historic and present use of adjacent and surrounding properties as various manufacturers with fuel oil tanks, paint shops, a coal and coke storage facility, and woodworking/lacquering facilities have the potential to impact the subsurface conditions at the Site.
- Adjoining and nearby facilities are listed under the environmental databases including New York Spills, Leaking Storage Tank Incident Reports (LTANKS), Solid Waste Facilities/Landfill Sites, Inactive Hazardous Waste Disposal Sites, and Engineering Controls.

The Phase I ESA identified the following Historical Recognized Environmental Condition (HREC):

- The Site is listed in the environmental database for multiple spill cases reported to the NYSDEC. All the listed spill cases reported on the Site are listed as "closed".

The Phase I ESA identified the following Controlled Recognized Environmental Condition (CRECs):

- The Site is located southeast of and adjacent to the former Bush Terminal Landfill (currently known as the Bush Terminal Piers Park) which is listed in the NYSDEC Environmental Restoration Program (ERP) as Site No. B00031-2. Primary contaminants of concern at the site include elevated levels of VOCs, SVOCS, metals, pesticides, and PCBs in soil, groundwater, and sediments. The site was remediated to restricted residential use and is currently a public park. The residual contamination at the site is managed by the NYSDEC-approved Site Management Plan which stipulates institutional controls, engineering controls, and a monitoring plan.

Based on the Environmental Consultant's review of the Phase I ESA, the Site's proximity to the former Bush Terminal Landfill Site is of environmental concern regarding soil vapor contamination and potential intrusion. The former Bush Terminal Landfill Site currently has a passive landfill gas management system to mitigate methane gas, a common landfill gas component, in order to ensure unsafe vapor intrusion conditions do not develop at the former Bush Terminal Landfill Site.

2.2.3 Phase II ESI, prepared by TRC, dated May 2020

This Phase II ESI was completed to evaluate the environmental concerns that were identified as part of the Phase I ESA completed in 2019.

Soil

A total of 39 soil samples were collected from 18 soil borings as part of the Phase II ESI and analyzed for NYSDEC CP-51/TCL VOCs, CP-51/TCL SVOCs, TCL pesticides, PCBs, and TAL metals. Laboratory results were compared to the NYSDEC UUSCOs, IUSCOs, and PGWSCOs. Soil analytical data from this investigation yielded exceedances of UUSCOs, IUSCOs, and/or PGWSCOs for SVOCs, metals, PCBs, and pesticides. There were no exceedances of UUSCOs, IUSCOs, and/or PGWSCOs for VOCs identified in the Phase II ESI.

- SVOCs, specifically PAHs, exceeded IUSCOs in 12 soil samples at depths ranging from 0-2 to 5-7 ft bls. Exceedances included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Additional PAH's that were below IUSCOs but above PGWSCOs and/or UUSCOs were acenaphthene, benzo(k)fluoranthene, chrysene, dibenzofuran, fluorene, naphthalene, and phenanthrene.
- The IUSCO for arsenic was exceeded in eight soil samples at depths ranging from 0-2 to 4-6 ft bls. Metal detections that were below the IUSCOs but above PSWSCOs and/or UUSCOs included beryllium, chromium (total), copper, lead, mercury, nickel, and zinc.
- PCBs were not detected above IUSCOs but were detected above PGWSCOs in one sample, TRC-SB-21 (6-8 ft bls), and above UUSCOs in 10 samples at depths ranging from 0-2 to 6-8 ft bls.
- There were no exceedances of IUSCOs or PGWSCOs for pesticides, however, six soil samples exceeded UUSOS for 4,4'-DDE, 4,4'-DDT, and 4,4'-DDD at depths ranging from 0-2 to 4-6 ft bls.

Groundwater

Fifteen groundwater samples (including one duplicate sample) were collected from 14 temporary monitoring wells and were analyzed for the same suite of analysis as described above in the soil results section, including both dissolved and total metals. Groundwater concentrations of VOCs, SVOCs, and total and dissolved metals exceeded the NYSDEC AWQSGVs. Additional information on groundwater exceedances is provided below:

- VOCs were detected above AWQSGVs in three groundwater samples collected from TRC-GW-02, TRC-GW-03, and TRC-GW-10 all located in the southern portion of the Site, in the vicinity of buildings 57 and 58. VOC exceedances included 1,1-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene.
- One groundwater sample collected from TRC-GW-22, located on the northern portion of the Site, exceeded AWQSGVs marginally for naphthalene.
- All groundwater samples collected as part of the Phase II ESI yielded an exceedance of AWQSGVs for total metals. Exceedances included antimony, arsenic, chromium (total), copper, iron, lead, magnesium, manganese, nickel, selenium, and sodium. The following metals also exceeded AWQSGVs for dissolved metals: antimony, iron, manganese, and sodium.

Soil Vapor

Thirteen soil vapor samples, two indoor air samples, and one outdoor ambient air samples were collected as part of the Phase II ESI. Soil vapor samples were collected from approximately 5 ft bls, one indoor air sample per building (building 57 and 58) was collected at approximately 3 to 5 feet to simulate a typical breathing zone. The Environmental Consultant completed an evaluation of the soil vapor data collected as part of the Phase II ESI and compared to the NYSDOH SVI Guidance, as amended. The highest concentration of total petroleum-related VOCs collected during the Phase II ESI were detected at TRC-SV-22, located in the northern portion of the Site near closed spill #0102496. Benzene was detected at 54.6 ug/m^3, toluene was detected at 32.6 ug/m^3, ethylbenzene was detected at 97.3 ug/m^3, o-xylene was detected at 22.8 ug/m^3, and m,p-xylene was detected at 69.5 ug/m^3. Currently, there are no standards or guidance values for these compounds set by NYSDEC or NYSDOH.

CVOCs were also detected at elevated concentrations at the Site. The NYSDOH SVI Guidance provides three matrices with guidance values for sub-slab and indoor air comparison for eight CVOCs. The concentrations considered in the matrix are intended for the comparison of sub-slab vapor concentrations from beneath an existing building and indoor air within the building. Since sub-slab samples were not collected as part of this Phase II ESI, a direct comparison cannot be made, however, the matrices can still be used as an evaluation for the presence of these compounds in soil vapor. The concentrations of the CVOC detections are summarized below:

Matrix A Compounds: carbon tetrachloride, cis-1,2-dichloroethene, 1,1-dichloroethene, TCE

- Maximum concentration of 1,1-dichlorothene was detected at TRC-SV-12 at 11.2 ug/m3.
- Maximum concentration of carbon tetrachloride was detected at TRC-SV-12 at 3.71 ug/m3.
- The only detection of cis-1,2-dichlorothene was detected at TRC-SV-03 at 1.44 ug/m3.
- Maximum concentration of TCE was detected at soil vapor sample TRC-SV-10 at 177 ug/m3.

Matrix B Compounds: PCE, 1,1,1-trichloroethane, methylene chloride

- Maximum concentration of 1,1,1-trichloroethane was detected at TRC-SV-10 at 43.3 ug/m3.
- Maximum concentration of PCE was detected at soil vapor sample TRC-SV-05 at 384 ug/m3.
- Maximum concentration of methylene chloride was detected at TRC-SV-13 at 7.96 ug/m3.

Matrix C Compound: vinyl chloride

- The only detection of vinyl chloride was detected at TRC-SV-22 at 12.5 ug/m^3.

2.2.4 Supplemental Phase II ESI, prepared by TRC, dated April 2020

A supplemental investigation was completed that included additional analyses of soil samples at select soil boring locations completed during the Phase II ESI. The initial Phase II ESI was completed to meet the investigation requirements of NYCDEP. The Supplemental Phase II ESI was implemented to investigate additional due diligence items at the request of the Applicant. A total of 20 soil samples were collected from 17 soil borings, 15 of which were completed as part of the Phase II ESI and 2 of which were completed as part of the Supplemental Phase II ESI.

Soil

Four soil samples were analyzed for VOCs, SVOCs, PCBs, metals, and pesticides as part of the Supplemental Phase II ESI. In addition, 16 soil samples from the original investigation were analyzed for emerging contaminants (per- and polyfluoroalkyl substances [PFAS] and 1,4-dioxane) and herbicides. The soil data from the Supplemental Phase II ESI was compared to NYSDEC UUSCOs, IUSCOs, and PGWSCOs. Soil analytical data from this investigation did not yield exceedances of IUSCOs. Two soil samples exceeded UUSCOs for zinc at 0-2 ft bls and 3-5 ft bls, one soil sample exceeded UUSCOs for nickel at 7-9 ft bls. There were four exceedances of UUSCOs, at depths ranging from 4-6 to 6-8 ft bls, and one exceedance of PGWSCOs, at 4-6 ft bls, for perfluorooctanoic Acid (PFOA) and one exceedance of UUSCOs for perfluorooctanesulfonic Acid (PFOS), at 4-6 ft bls, collected during the Supplemental Phase II ESI.

Groundwater

Two groundwater samples were collected and analyzed for VOCs, SVOCs, PCBs, metals (total and dissolved), and pesticides and six groundwater samples were analyzed for emerging contaminants and herbicides. Groundwater concentrations of metals and PCBs exceeded the NYSDEC AWQSGVs. More information on groundwater exceedances is provided below:

- Both groundwater samples that were analyzed for metals yielded an exceedance of AWQSGVs for total metals. Exceedances included antimony, arsenic, chromium (total), copper, iron, lead, manganese, and sodium. The following metals also exceeded AWQSGVs for dissolved metals: iron, manganese, and sodium.
- Groundwater sample TRC-GW-24 exceeded AWQSGVs for PCBs with a concentration of 0.81 ug/L.
- Since emerging contaminants are not currently included as part of the AWQSGVs, the groundwater analytical results were compared to the screening levels provided in the NYSDEC guidance document titled “Sampling, Analysis, and Assessment of PFAS”, dated January 2021. PFOA and PFOS were compared to 10 ng/L with six groundwater samples exceeding this screening level.

Soil Vapor

Eight soil vapor samples and two indoor air samples were collected as part of the Supplemental Phase II ESI. Soil vapor samples were collected from approximately 5 ft bls, one indoor air sample per building (building 57 and 58) was collected at approximately 3 to 5 feet above the surface of the floor slab to simulate a typical breathing zone. The Environmental Consultant completed an evaluation of the soil vapor data collected as part of the Supplemental Phase II ESI and compared to the NYSDOH SVI Guidance, as amended. The highest concentration of petroleum-related VOCs collected as part of the Supplemental Phase II ESI were detected at TRC-SV-26, located at the northeast corner of building 57. Benzene was detected at 6.64 ug/m^3, toluene was detected at 17.4 ug/m^3, ethylbenzene was detected at 9.21 ug/m^3, o-xylene was detected at 10 ug/m^3, and m,p-xylene was detected at 25.8 ug/m^3. Currently, there are no standards or guidance values for these compounds set by NYSDEC or NYSDOH.

CVOCs were also detected at elevated concentrations at the Site. The NYSDOH SVI Guidance provides three matrices with guidance values for sub-slab and indoor air comparison for eight CVOCs. The concentrations considered in the matrix are intended for the comparison of sub-slab vapor concentrations from beneath an existing building and indoor air within the building. Since sub-slab samples were not collected as part of this Supplemental Phase II ESI, a direct comparison cannot be made, however, the matrices can still be used as an evaluation for the presence of these compounds in soil vapor. The concentrations of the CVOC detections are summarized below:

Matrix A Compounds: carbon tetrachloride, cis-1,2-dichloroethene, 1,1-dichloroethene, TCE

- Maximum concentration of 1,1-dichlorothene was detected at TRC-SV-25 at 61.9 ug/m3.
- The only detection of carbon tetrachloride was detected at TRC-SV-26 at 41.6 ug/m3.
- Maximum concentration of cis-1,2-dichlorothene was detected at TRC-SV-25 at 23.1 ug/m3.
- Maximum concentration of TCE was detected at TRC-SV-25 at 548 ug/m3.

Matrix B Compounds: PCE, 1,1,1-trichloroethane, methylene chloride

- Maximum concentration of 1,1,1-trichloroethane was detected at TRC-SV-25 at 39.1 ug/m3.
- Maximum concentration of PCE was detected at soil vapor samples TRC-SV-28 at 1,480 ug/m3.
- Methylene chloride was not detected in soil vapor.

Matrix C Compound: vinyl chloride

- The only detection of vinyl chloride was detected at TRC-SV-27 at 0.792 ug/m^3.

2.2.5 NYSDEC Spill Incidents and Underground Storage Tanks

There are currently no open spills for the Site, however the Site is listed on the New York State Department of Environmental Conservation (NYSDEC) spills database for the following closed spills:

- *Spill #9508159:* the spill was reported on October 3, 1995 and is related to a truck valve malfunction. The spill was contained, and the spill case was closed on October 3, 1995.
- *Spill #9802957:* the spill occurred on June 2, 1998 and was reported on June 5, 1998. The spill is related to a Site investigation that discovered five buried drums containing pesticides. All five drums were removed and 120 tons of soil were excavated and disposed off-site. The spill case was closed on June 5, 1998.
- *Spill #1306670:* the spill was reported on September 25, 2013, during the implementation of a Remedial Investigation (2013 RI) by GCE and is related to an approximately 20 ft by 10 ft area of soil with visible staining associated with one 275-gallon oil aboveground storage tank (AST). The spill was due to poor housekeeping. No additional information regarding remedial actions was provided in the reports, however, the spill case was noted as closed on September 30, 2013.
- *Spill #1306669:* the spill was reported on September 25, 2013, during the implementation of the 2013 RI by GCE and is related to surface staining in the proximity of a different 275-gallon AST from the one associated with Spill #1306670, located to the south of building 45. The cause of the spill is related to poor housekeeping from the contractors. The area of the spill was excavated and approximately 25 tons of soil were removed. Post-excavation samples all yielded non-detect results. The spill case was closed on January 26, 2016.

- *Spill #0102496:* the spill was reported on June 5, 2001 and is related to observed petroleum-impacted soil during test pit excavation outside of the northeastern loading dock of building 39/40. The spill is recorded as an unknown amount of solvents spilled onto the soil. No additional information regarding remedial actions was provided in the reports, however, the spill case was closed on September 13, 2005.

The geophysical survey completed as part of the 2013 RI identified several anomalies and potential underground storage tank (UST) features, as summarized below:

Location	# of Anomalies Observed	Surface Features Observed	Additional Comments
North of former building 45	2	Fill port	- Aboveground storage tank (AST) (associated with spill #1306670) and drum storage area located directly adjacent to the east. - Multiple refusals surrounding fill pipe location during 2013 RI field work.
South of former building 40	4	Fill port and concrete pad	None

The Phase I ESA and Phase II ESI, both completed in 2020, reported that no USTs, ASTs, vent pipes, fill ports, or dispensing equipment were observed during the Site visit/field work implementation.

3. Objectives, Rationale, and Scope

The Environmental Consultant, on behalf of the Applicant, has developed a RI scope of work (presented in this RIWP/IRMWP) that is intended to satisfy NYSDEC BCP requirements to delineate the nature and extent of contamination and allow for effective evaluation of multiple BCP cleanup track alternatives. Data collected during the RI will determine the basis for future Remedial Actions for the Site.

Standards, Criteria, and Guidance (SCGs) for soil at BCP Sites are the numerical soil cleanup objectives (SCOs) presented in 6 NYCRR Part 375. The SCOs are categorized into unrestricted use criteria and restricted use (Residential, Restricted Residential, Commercial, or Industrial) criteria, as well as criteria for protection of groundwater (PGW) and ecological resources. The applicability of each category of SCOs is determined based upon the current and reasonably anticipated future use of the Site, as well as cleanup tracks being evaluated.

Based on the anticipated industrial use of the Site, the applicable standards are UUSCOs if a Track 1 remedy is contemplated, or IUSCOs if Track 2 or Track 4 remedies are contemplated.

Although the groundwater beneath the Site is not used as a drinking water source, the NYSDEC AWQSGVs – TOGS 1.1.1. will be considered when evaluating groundwater data.

The NYSDOH Guidance employs three matrices to determine whether monitoring or mitigation of soil vapor levels are warranted, based on concentrations present in sub-slab and indoor air samples. Potential soil vapor impacts identified in accordance with the NYSDOH guidance will be considered. With respect to the petroleum-related vapors identified in the previous investigations, the Environmental Consultant will also evaluate the final data in relation to the June 2015 USEPA Soil Vapor Guidance document since the State of New York does not yet have soil vapor guidance for petroleum hydrocarbons.

3.1 Objectives

Based on the existing data for the Site, as summarized in Section 2.2, the following objectives have been identified for the RIWP:

- Further delineate the nature and extent of potential impacts to soil from the AOCs described below;
- Delineate the nature and extent of impacts to groundwater;
- Delineate the nature and extent of impacts to soil vapor; and
- A qualitative human health exposure assessment will be completed and will consider the nature of populations currently exposed or that have the potential to be exposed to Site related contaminants both on and offsite and will describe the reasonably anticipated future land use of the Site and affected offsite areas.

The RI will evaluate soil, groundwater, and soil vapor impacts onsite and at the property boundaries to provide the basis for remedial action selection and to determine the potential for offsite impacts. Environmental data collected during the RI will be used to qualitatively assess the potential exposure of receptors to Site contaminants and develop the information necessary to support the development of a RAWP.

3.2 RI Scope

The analytical data summarized in the Phase II ESI and Supplemental Phase II ESI accurately characterizes soil conditions at discrete intervals at the Site. The additional investigation proposed in this RIWP will supplement that existing data. In order to incorporate the prior soil data into the Environmental Consultant's Remedial Investigation Report/Remedial Action Work Plan (RIR/RAWP), a Data Usability Summary Report (DUSR) will be performed to validate all soil samples collected as part of the previously completed Phase II ESI and Supplemental Phase II ESI. The analytical data from the 2013 RI was used as a preliminary screening level to select the locations of the proposed RI samples; since NYSDEC Analytical Services Protocols (ASP) Category B reports were not attached in the 2013 RI, this data will not be included in the DUSR submitted as part of the RIR/RAWP prepared for the Site.

The scope of the RI will include the collection of sufficient Site characterization data so that, together with the historical data, the entire Site will be sufficiently characterized to support the development of the Site-wide RAWP. Additionally, the RI will include a qualitative human health exposure assessment and will consider the nature of populations currently exposed or that have the potential to be exposed to Site related contaminants both on and offsite and will describe the reasonably anticipated future land use of the Site and affected offsite areas. To accomplish this, the scope of work for the RI will include the following:

- The performance of Site reconnaissance to confirm proposed sampling locations;
- The advancement of 19 soil borings and/or test pits, when necessary, depending on Site access;
- The installation of 4 permanent groundwater monitoring wells, three temporary monitoring wells, and one2 temporary soil vapor point;
- The collection of 35 soil samples, ten groundwater samples (four samples from newly installed permanent monitoring wells, three from newly installed temporary monitoring wells, and three from existing onsite monitoring wells), three soil vapor samples, and four indoor air samples sufficient to define the nature and extent of impacted media and current Site conditions;
- The collection of groundwater level measurements and land survey data as needed for developing a groundwater elevation contour map; and
- The performance of a qualitative Exposure Assessment (EA) to identify exposure pathways and evaluate contaminant fate and transport.

A summary of the sample locations associated with each AOC, is provided in the table below:

AOC ID	AOC Rationale	Sample Location IDs	Target Soil Sample Depths	Anticipated Sample Collection Method
AOC-1	Presence of soil and groundwater contamination due to several onsite releases, summarized in Section 2.3.5, including petroleum hydrocarbons, chlorinated solvents, and pesticides. Soil borings and monitoring wells will be installed Site-wide to fill in the spatial distribution of analytical data.	RXSB-1/RXMW-1	0-2 ft	Soil boring
			9-11 ft[1]	
		RXSB-2/RXMW-2	0-2 ft	Soil boring
			4-6 ft[1]	
		RXSB-3/RXMW-3	0-2 ft	Soil boring
			4-6 ft[1]	
		RXSB-4/RXMW-4	0-2 ft,	Soil boring
			5-7 ft[1]	
		RXSB-5	0-2 ft,	Soil boring or test pit
			9-11 ft[1]	
		RXSB-7	0-2 ft	Soil boring or test pit
			9-11 ft[1]	
		RXSB-10	0-2 ft	Soil boring or test pit
			7-9 ft[1]	
		RXSB-11	0-2 ft	Soil boring or test pit
			7-9 ft[1]	

AOC ID	AOC Rationale	Sample Location IDs	Target Soil Sample Depths	Anticipated Sample Collection Method
AOC-2	Presence of soil contamination due to inadvertent releases associated with the Site's industrial and manufacturing history as a distribution center including several warehouses and a rail yard. Additional soil borings will be installed adjacent to the remaining and former locations of the historical warehouses to evaluate potential inadvertent releases associated with the loading/unloading area located adjacent to the building loading docks and the rail lines.	RXSB-6	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-8	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-9	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-15	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-16	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-17	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-18	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-19	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
AOC-3	Evaluation of the potential presence of soil and groundwater contamination below unit G, which currently is identified as a data gap with no analytical data within the footprint of the currently vacant building. Evaluation of groundwater conditions downgradient of unit G.	RXSB-12/RXTW-1	8-10[1]	Soil boring
		RXSB-13/RXTW-2	8-10[1]	Soil boring
		RXSB-14/RXTW-3	8-10[1]	Soil boring
		RXMW-7	NA[3]	NA
AOC-4	Confirmation and evaluation of TCE detection at soil vapor sample location SV-2, collected during the 2013 RI.	RXSV-1	NA	Soil boring
		RXSV-2	NA	Soil boring
		RXSV-3	NA	Soil boring
AOC-5	Buildings 57 and 58 potential soil vapor intrusion evaluation and downgradient groundwater conditions.	RXIA-57-1	NA	NA
		RXIA-57-2	NA	NA
		RXIA-58-1	NA	NA
		RXIA-57-2	NA	NA

		RXMW-5	NA[3]	NA
		RXMW-6	NA[3]	NA

1 - Soil sample will be collected from the two-foot interval exhibiting the greatest evidence of impact (elevated PID detections, odors, or staining). If no evidence of impacts is observed during soil boring advancement, the soil sample will be obtained from the two-foot interval immediately above the water table.

2 – Soil sample to be collected from the two-foot interval directly below remaining historical rail lines.

3 – Groundwater sample will be collected from existing onsite monitoring wells, as depicted on Figure 9, following confirmation of well construction and conditions. If well construction cannot be confirmed and/or monitoring wells are found to be in poor condition, new permanent wells will be installed, gauged, and sampled as detailed in Section 3.2.3.

4 – Soil sample to be collected from the 0-2 inch interval below the vegetative cover (if applicable) of representative onsite historical soil. Soil to be sampled will not include existing onsite asphalt, concrete, recycled concrete aggregate (RCA) subbase, rail line track ballast, or soil exhibiting characteristics of previously imported clean material. The 0-2 inch soil samples will not be analyzed for emerging contaminants.

The overall scope of each component of the RI is discussed in the following subsections. Detailed field sampling procedures are provided in the Quality Assurance Project Plan/Field Sampling Plan (QAPP/FSP) included as Appendix B. The proposed sampling locations are shown on Figure 9 of this RIWP and additional information, including intervals to be sampled and sample rationale, is provided in the sections below.

3.2.1 Site Reconnaissance

The Environmental Consultant has reviewed the previously completed environmental reports and has identified potential AOCs, described in Section 3.1, which will be targeted with soil, groundwater, and soil vapor samples during the RI. The Environmental Consultant will perform a Site reconnaissance prior to the implementation of the subsurface investigation. An inspection of the existing Site conditions will be conducted to determine final sampling locations based on actual field conditions. The current layout of the proposed sampling locations, as shown in Figure 9, was developed to provide coverage across the entire Site footprint. Based on the Site reconnaissance, the layout of proposed sampling locations may change. If proposed sampling locations are adjusted more than 10 ft from their original location on Figure 9, the Environmental Consultant will notify NYSDEC prior to installation or sampling.

3.2.2 Soil Investigation

Dependent on Site logistics and investigation schedule, soil samples may be collected via soil boring completed using a Geoprobe direct push drill rig or a test pit by an excavator. To collect additional data to delineate contamination at the Site, soil samples will be collected from the 19 soil borings or test pits at the locations shown in Figure 9. At soil boring locations, pre-clearance will be completed to five ft bls using non-intrusive methods, such as vacuum clearance and hand tools to verify the absence of utilities and/or other subsurface features (i.e., obstructions and/or refusal). Should a utility or other feature be observed during pre-clearance activities, the sampling location will be relocated to no more than 10 ft away from the original proposed sample location. If a boring is proposed to be moved more than 10 ft from the location shown on Figure 9, the NYSDEC project manager will be consulted prior to installing the boring at the new location. Pre-clearance will not be completed if samples are collected via test pit.

Soil will be collected continuously from land surface to the targeted sample interval summarized in the table above for soil borings and to approximately 20 ft bls for locations that will include monitoring well installation (to allow for optimal well depth). Soil boring locations that will be converted into permanent well locations or soil vapor points, will not be complete via test pit. During advancement of borings, the soil will be inspected for evidence of contamination (visual and olfactory) and field screened continuously for organic vapors using a PID with a 10.6 eV lamp. Soil lithology will be recorded according to the Unified Soils Classification System (USCS).

All soil samples will be analyzed for the following list of parameters:

- Target Compound List (TCL)/NYSDEC Part 375 volatile organic compounds (VOCs);
- TCL/NYSDEC Part 375 semivolatile organic compounds (SVOCs);
- TCL/NYSDEC Part 375 pesticides;
- TCL/NYSDEC Part 375 herbicides;
- TCL/NYSDEC Part 375 polychlorinated Biphenyls (PCBs);
- Total Analyte List (TAL)/NYSDEC Part 375 metals (including hexavalent chromium, trivalent chromium, and total cyanide); and
- Emerging Contaminants* (ECs) (excluding samples collected from 0-2 inches bls).

*As required by NYSDEC, soil samples will be analyzed for the emerging contaminants (ECs) 1,4-Dioxane and PFAS, which include the 21 compounds listed in accordance with the Sampling, Analysis, and Assessment of PFAS under NYSDEC's Part 375 Remedial Programs guidance document (NYSDEC January 2021 PFAS Guidance).

Two additional blind duplicate soil sample, two matrix spike (MS) soil sample, two matrix spike duplicate (MSD) soil sample, field blanks, and trip blanks, as necessary, will be collected for QA/QC purposes. Additional details regarding sampling methods are provided in the QAPP/FSP (Appendix B).

Following sample collection, soil cuttings will be returned to the boring to the extent possible to reduce the quantity of drummed waste. If grossly impacted soil is encountered, it will not be returned to the boring and will be placed into labelled 55-gallon steel drums and stored onsite pending offsite disposal.

3.2.3 Groundwater Investigation

To characterize onsite groundwater flow and groundwater quality, four new permanent groundwater monitoring wells and three new temporary monitoring wells will be installed for sampling and analysis. Additionally, three existing onsite monitoring wells located downgradient of buildings 57, 58, and unit G, will be sampled, following confirmation of monitoring well construction and conditions. If well construction cannot be confirmed and/or the three monitoring wells are found to be in poor condition, three new permanent wells will be installed, gauged, and sampled. The proposed RI monitoring well locations are shown on Figure 9.

The monitoring wells will be installed to provide a better understanding of onsite groundwater flow and to fill groundwater quality data gaps from prior groundwater investigations. Permanent monitoring wells will be installed using a Geoprobe with hollow stem augers and constructed with a minimum of 10 ft of two-inch diameter, 0.02-inch slotted Schedule 40 polyvinyl chloride (PVC) screen set to straddle the water table. The temporary monitoring wells will be constructed with a minimum of 10 ft of one-inch diameter, 0.02-inch slotted

Schedule 40 PVC screen. The QAPP/FSP in Appendix B contains further monitoring well design and construction details.

The new permanent monitoring wells will be developed following installation to establish good hydraulic connection between the well and surrounding formation. No sooner than one week following their installation, a comprehensive water-level gauging event will occur prior to groundwater sampling to characterize groundwater flow onsite. Groundwater in each well will be measured using an electronic oil-water interface probe and a groundwater contour map will be developed using the gauging and survey data (as described in Section 3.2.6). Following purging, groundwater samples will be collected from the newly installed permanent monitoring wells. Groundwater grab samples will be collected directly following temporary monitoring well installation. Following groundwater grab sample collection, the one-inch PVC will be removed and the borehole will be backfilled to grade. Detailed procedures regarding well development and sampling procedures are provided in the QAPP/FSP (Appendix B).

Ten groundwater samples will be collected for laboratory analysis (not including QA/QC samples). All groundwater samples will be analyzed for the parameters listed below:

- TCL/NYSDEC Part 375 VOCs;
- TCL/NYSDEC Part 375 SVOCs;
- TCL/NYSDEC Part 375 pesticides;
- TCL/NYSDEC Part 375 herbicides;
- TCL/NYSDEC Part 375 PCBs;
- TAL/NYSDEC Part 375 total and dissolved metals (including hexavalent chromium, trivalent chromium, and total cyanide); and
- ECs*.

Groundwater samples will be filtered by the laboratory for metals and both filtered and unfiltered results will be reported.

*As required by NYSDEC, groundwater samples will also be analyzed for the ECs 1,4-Dioxane and PFAS, which include the 21 compounds listed in the NYSDEC January 2021 Guidance.

Additionally, one blind duplicate groundwater sample, one MS groundwater sample, one MSD groundwater sample, field blanks, and trip blanks will be collected for QA/QC purposes. Additional details regarding sampling methods are provided in the QAPP/FSP (Appendix B). Water generated as part of the well development and purging effort prior to sample collection will be drummed, labeled, sampled, and stored onsite pending disposal.

3.2.4 Soil Vapor Investigation

As discussed in Sections 2.2.3 and 2.2.4, a total of 21 soil vapor samples have been collected Site-wide as part of the Phase II ESI and Supplemental Phase II ESI, which will ultimately be validated and included as part of the RIR/RAWP. Therefore, the onsite soil vapor conditions have been fully investigated with the exception of two areas: SV-2 collected during the 2013 RI, and the indoor air from the lowest floor proposed to be occupied as part of the redevelopment of existing buildings 57 and 58.

SV-2 was collected as part of the 2013 RI and yielded a TCE concentration of 607 ug/m^3. Since NYSDEC ASP Category B reports were not attached in the 2013 RI, three soil vapor sample locations are proposed to be installed as part of the RI to confirm and evaluate the high concentration of TCE identified at SV-2.

The soil vapor monitoring points will be installed at approximately two feet above the observed water table based on field observations while advancing soil borings. The soil vapor sample locations will be installed using a six-inch long, stainless steel sample screen attached to Teflon-lined polyethylene sample tubing. Surrounding the screen and sample tubing, #2 Morie sand will be added to six-inches above the top of the screen. A one-foot thick layer of non-VOC containing and non-shrinking bentonite product will be added to the top of the sand and left to hydrate. Additional details regarding soil vapor point construction is provided in the QAPP/FSP (Appendix B).

Additionally, to evaluate the potential for soil vapor intrusion at existing buildings 57 and 58, two indoor air samples will be collected at the breathing zone from the lowest floor proposed to be occupied as part of the redevelopment of each building, for a total of four indoor air samples. The proposed RI soil vapor and indoor air sample locations are shown on Figure 9.

The soil vapor and indoor air samples will be collected for laboratory analysis of VOCs using United States Environmental Protection Agency (USEPA) Method TO-15. One blind duplicate soil vapor sample and one ambient air sample will also be collected for QA/QC purposes. The soil vapor and indoor air samples will be collected using pre-cleaned 6-liter summa canisters with flow regulators that have been batch certified and calibrated to collect samples over an eight-hour period. A tracer gas will be employed prior to the collection of the soil vapor sample to ensure the integrity of the vapor probe seal and to verify that the vapor samples do not become inadvertently diluted with ambient air. A NYSDOH Indoor Air Quality Questionnaire and Building Inventory form will be completed as part of the indoor air sampling at buildings 57 and 58. A copy of the NYSDOH Indoor Air Quality Questionnaire and Building Inventory form is included in the QAPP/FSP. Field parameters will be recorded on vapor sampling data forms and included in the RI Report. Additional details regarding sampling methods are provided in the QAPP/FSP (Appendix B).

3.2.5 Investigation Laboratory Analysis

All samples will be analyzed at a NYSDOH Environmental Laboratory Approval Program-certified (ELAP) laboratory. Additional details regarding laboratory analyses are included in the QAPP/FSP (Appendix B). All analytical data for the RI will be received with standard 5-day turn-around-time.

All RI data will be produced in accordance with NYSDEC ASP Category B deliverables and will be reviewed and validated by a third-party data validator, who will prepare a Data Usability Summary Report (DUSR) before being incorporated into the final RIR for the Site. All data will be submitted to NYSDEC in electronic format, in accordance with DER-10, Section 1.15.

3.2.6 Surveying Assessment

All newly installed monitoring wells and existing monitoring wells sampled as part of this RI will be surveyed by a New York Licensed Surveyor to obtain horizontal and vertical coordinates and grade elevations. Measuring point elevations from newly installed monitoring wells will also be surveyed to enable groundwater flow contouring. Horizontal coordinates will be based upon New York State Plane Coordinate System, Long Island Zone, North American Datum of 1983 (NAD 83) in US Survey Feet. Vertical elevations will be measured for top-of-casing (measuring point) and grade elevations referenced to North American Vertical Datum of 1988 (NAVD88).

3.2.7 Investigation Derived Waste

Purge water and visibly impacted drill cuttings generated as part of the investigation will be drummed, labeled, sampled, and stored onsite pending laboratory results. Disposal will be coordinated following the receipt of laboratory results.

3.2.8 Community Air Monitoring Plan

The Environmental Consultant will implement the Community Air Monitoring Plan (CAMP) during any intrusive subsurface activities to conduct monitoring and protection for potential offsite receptors. The CAMP scope of work will include the use of one downwind air monitoring station and one upwind air monitoring station each equipped with one PID and one particulate meter. Upwind concentrations will be measured at the start of each workday and periodically throughout the day to establish background concentrations. Daily reporting of any exceedances will be provided to the NYSDEC and NYSDOH. The results of the CAMP data will be provided to the NYSDEC and NYSDOH on a weekly basis. CAMP data results will be provided in the final RIR along with locations of perimeter monitoring stations, monitoring equipment, procedures, and contaminant action levels. The NYSDOH Generic CAMP is included as Appendix C of this RIWP/IRMWP.

3.2.9 Qualitative Exposure Assessment

A qualitative human health EA will be performed following the collection of all RI data. The EA will be performed in accordance with Section 3.3(c)4 of DER-10 and the NYSDOH guidance for performing a qualitative EA (DER-10; Appendix 3B). The results of the qualitative EA will be provided in the RIR.

According to Section 3.10 of DER-10, and the Fish and Wildlife Resources Impact Analysis Decision Key in DER-10 Appendix 3C, a Fish and Wildlife EA is not needed for this Site.

3.3 Quality Assurance/ Quality Control (QA/QC) Protocols

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

3.4 Health and Safety

A HASP has been prepared for the Site and is provided in Appendix D. The NYSDOH Generic CAMP is provided within Appendix C of this RIWP/IRMWP.

4. Elements of the Interim Remedial Measure

4.1 Objectives and Rationale

The objectives of the IRM are as follows:

- Complete building demolition of unit G and limited below-grade foundation removal. Demolition of this structure is required to complete the RI of the Site in order to allow for safe and unimpeded access to all sampling locations. Unit G is constructed with a full cellar basement which currently has several feet of standing water observed due to poor drainage. Due to inaccessibility and unsafe conditions in the unit G cellar, the building will need to be demolished and backfilled with approved material prior to investigating AOC-3, as discussed in Section 3.1; and
- Remove any potential remaining underground storage tanks (USTs) or grossly impacted materials if encountered during demolition of foundation elements.

The following sections provide additional details concerning the completion of the IRM objectives.

4.2 Mobilization and Site Preparation

The NYSDEC will be provided with at least five days advanced notice prior to intrusive activities. The selected Contractor will supply labor (Hazardous Waste Operations and Emergency Response [HAZWOPER] Certified in accordance with OSHA 1910.120) and materials required for the implementation of the RI/IRM scope of work. In addition, necessary permits, insurance, bonds, and licenses required to complete the work will be obtained and fees necessary to obtain these permits will be paid. For the RI scope of work, this will include mobilization of equipment to the work area. Once demolition commences, the mobilization and Site preparation activities include:

1. Mobilization of equipment to the work area.
2. Installation of construction fencing (in accordance with New York City Department of Buildings [NYCDOB] requirements) and traffic barricades surrounding the Site to delineate the work zone, act as a work Site security measure, and mark the truck loading and decontamination areas.
3. It is anticipated that more than 1 acre of land will be disturbed as part of the unit G demolition scope of work. Therefore, a Stormwater Pollution Prevention Plan (SWPPP) will be prepared in conjunction with the attainment of a General Permit. Hay bales and/or silt fencing will be placed surrounding the excavation areas to control stormwater runoff and surface water from entering or exiting the excavation, as necessary. Catch basin inlets will be protected to prevent demolition debris or disturbed soil from entering.
4. Set-up of staging areas for excavation areas, as necessary; and
5. Set-up of temporary facilities and decontamination facilities including decontamination pad in order to decontaminate trucks and other vehicles/equipment, as necessary.

4.3 Building Demolition

During prior Site reconnaissance, several feet of standing water was observed within the basement of unit G and therefore the area is currently unsafe and inaccessible to complete work. Based on groundwater gauging completed as part of previous investigations, groundwater elevations vary and may be tidally influenced. It is anticipated that the water observed in the basement if unit G may be a mix of stormwater from roof drains and infiltrating groundwater. As part of the RIWP/IRMWP scope of work, groundwater elevations will be further evaluated through the gauging of nearby existing downgradient monitoring wells and field observation during building demolition.

At unit G, asbestos containing material (ACM) was identified during previously completed hazardous material inspections. ACM abatement will be required to facilitate the demolition of unit G and subsequent completion of the RI. During asbestos abatement, all work will be completed and material will be disposed of in accordance with federal, state, and local regulations. Following asbestos abatement, building demolition of unit G will include the dismantling of above-grade structures, and minimal slab demolition. Minimal slab demolition will be completed following an evaluation of groundwater elevations in the area and will be limited to cracking of the slab to prevent ponding of water during precipitation events. In the limited areas of slab demolition, the surface soil will be screened with a PID. If grossly impacted soil is observed at the surface in accessible portions of the Site, the Applicant will communicate findings to the NYSDEC Project Manager and discuss the remediation strategy and timing of the remediation. All non-masonry construction and demolition debris including wood, metal will be removed from the Site and will be transferred to a registered construction and demolition facility for offsite processing for recycling and disposal. Any grossly impacted materials, including but not limited to soil, concrete, and asphalt, will be segregated, and disposed of at a permitted offsite disposal facility in accordance with applicable regulations. For any grossly impacted material that is encountered during IRM activities that is not excavated and removed from the Site, remedial activities will be included and completed as part of the RAWP for the Site.

If soil is disturbed as part of the limited subgrade feature removal for the building demolition, the Environmental Consultant will provide oversight of any limited soil disturbance activities and conduct air monitoring in accordance with the CAMP. Oversight and CAMP will continue until the former building areas are stabilized and the exposed soil surfaces are covered with a temporarily cover consisting of 6” of stone or other NYSDEC-approved material. Details of the CAMP requirements are provided in Appendix C.

If the presence of groundwater, at elevations higher than the unit G cellar slab is confirmed during demolition of the unit G cellar, the former building’s cellar will be backfilled with virgin stone or clean soil, as approved by NYSDEC and in accordance with Section 5.9, to at least 1 foot above the seasonal high-water table. If groundwater is not encountered, recognizable and uncontaminated concrete, brick, and masonry from building demolition will be used to entirely backfill the building’s cellar to grade. The onsite reuse of demolition debris is consistent with NYSDEC DER-31 Green Remediation practices by maximizing the beneficial use or reuse of recognizable and uncontaminated building demolition debris. Recognizable and uncontaminated concrete, masonry and brick from the building demolition that meets the reuse requirements stipulated in Section 5.7 will be used to backfill the building’s cellar footprint to grade, following completion of ACM abatement and building demolition. A Request to Import/Reuse Fill or Soil form, or Case-Specific Beneficial Use Determination form, if applicable, will be submitted to NYSDEC for review and approval prior to onsite reuse of the appropriate building demolition debris.

Any accumulated stormwater and/or groundwater encountered during the IRM will be managed and discharged under the appropriate New York City and New York State permit and will follow all local, state, and federal regulations.

Following completion of the unit G building demolition and backfill, the investigation of AOC-3, as discussed in Section 3.1 will be completed.

4.4 Underground Storage Tank Removal Contingency

If unknown USTs are encountered, the applicant with notify the NYSDEC Project Manager. The UST will be decommissioned and removed by a Fire Department of the City of New York (FDNY) licensed installer/remover. Removal of the USTs will be performed in accordance with NYSDEC CP-51 Soil Cleanup Guidance Tables 2 and 3, Soil Cleanup Levels for Gas and Fuel Oil Contaminated Soil (CP-51 Soil Cleanup Guidance) and other applicable UST closure requirements. Upon completion of any potential UST removal, the area will be inspected for the presence of contamination in soil and groundwater. If grossly impacted material is encountered, the Applicant will communicate findings to the NYSDEC Project Manager and discuss the remediation strategy and timing of the remediation. Confirmation sampling will be completed in accordance with Sections 5.5 of DER-10 prior to backfilling in accordance with Section 5.9 herein or as stated in the RAWP. Following removal of any potential USTs, any potential USTs will be registered and closed in the NYSDEC Petroleum Bulk Storage (PBS) database and FDNY affidavits of closure will be obtained by a licensed UST installer/remover.

5. Soils/Materials Management Plan

Soil excavation is not anticipated as part of the scope outlined in this RIWP/IRMWP; however, the following sections provide the Soil/Materials Management Plan (SoMP) to be implemented in the event that limited excavation is required for the removal of subgrade features of unit G or impacted soil is encountered during demolition.

5.1 Building Material and Soil Screening Methods

Visual, olfactory, and PID soil screening and assessment will be performed during the RI/IRM activities under the supervision of the Environmental Consultant's personnel.

5.2 Stockpile Methods

Excavated materials will be directly loaded into trucks for offsite disposal and stockpiles will be used only when necessary. If necessary, soil excavated during Site redevelopment will be temporarily stockpiled or placed in roll-off containers until properly disposed of. While stockpiles are in place, they will be inspected at a minimum each week, and before and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All stockpiles that are not actively managed will be covered, inspected, and maintained in accordance with the SWPPP to be prepared for the Site.

Stockpile activities will be compliant with applicable laws and regulations. Stockpiles of excavated soils and other materials will be located a minimum of 20 feet from the property boundaries, where possible. Hay bales or equivalent Best Management Practice (BMP) will surround soil stockpiles as needed, except for areas where access by equipment is required. Hay bales or equivalent BMP will be used as needed near catch basins, surface waters, and other discharge points.

5.3 Characterization of Excavated Materials

If offsite disposal of material is required, the excavated media will be sampled in a manner required by the receiving facility, and in compliance with applicable laws and regulations. Soils proposed for reuse onsite will be managed as defined in this Work Plan.

5.4 Materials Excavation and Load-Out

The Environmental Consultant will oversee all invasive work, excavation, and load-out of material.

The Applicant and its contractors are solely responsible for safe execution of all invasive and other work performed under this Work Plan. The selected contractor will be required to place a One-Call Dig Safe notification prior to mobilization. In addition, existing private markout information, where available, will be consulted prior to excavation. Support of excavation will be provided, if necessary, based upon redevelopment plans, Site conditions, and local regulations.

The presence of easements on the Site has been investigated. It has been determined that no risk or impediment to the planned work under this RIWP/IRMWP is posed by easements on the Site. The presence of utilities within/adjacent to the proposed work area will be investigated prior to the work in order to determine if there are any impediments to the proposed scope of work. NYSDEC will be notified of any changes required to the scope of work based on the geophysical survey.

Loaded vehicles leaving the Site will be appropriately securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements). If grossly contaminated material is encountered, loaded vehicles will be lined and tarped, as appropriate.

Loaded outbound trucks will be inspected by the Environmental Consultant and cleaned by the Site contractor before leaving the Site.

Locations where vehicles enter or exit the Site shall be inspected daily for evidence of offsite sediment tracking. Vehicles/trucks will either be staged on asphalt/concrete, where still existing, or in the event that the asphalt/concrete is removed, a stabilized construction entrance will be constructed at any vehicle egress points. Regardless, all egress points for truck and equipment transport from the Site will be clean of dirt and other materials derived from the Site during the implementation of the IRM. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to Site-derived materials.

Mechanical processing of historic fill and contaminated soil onsite is prohibited.

5.5 Materials Transport Offsite

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

The proposed inbound truck route to the Site is:

- Take the Brooklyn Queens Expressway (I-278) to exit 23 toward 39th Street. Continue straight on 39th Street for 0.2 miles and turn left onto 1st Avenue. Continue on 1st Avenue 0.5 miles and entrance to the Site will be on the right.

The proposed outbound truck route from the Site is:

- Turn left out of the Site and continue on 1st Avenue for 0.5 miles then turn right onto 39th street. Continue on 39th Street for 0.3 miles before turning left onto 3rd Avenue. Continue straight on 3rd Avenue for 1.2 miles before turning left onto Hamilton Avenue and continue straight on Hamilton Avenue for 0.9 miles. Take I-278 E ramp to Brooklyn Queens Expressway.

These are the most appropriate routes and take into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting offsite queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport. To the extent possible, trucks loaded with Site materials will travel to/from the Site using these approved truck routes. 3rd Avenue, 39th Street, 1st Avenue, and Hamilton Avenue are New York City Department of Transportation approved Local Truck Routes.

Trucks will avoid stopping and idling in the neighborhood outside the project Site, to the extent practicable. Queuing of trucks will be performed onsite, when possible, in order to minimize off Site disturbance. Offsite queuing will be minimized.

Egress points for truck and equipment transport from the Site will be kept clean of dirt and other materials during the IRM implementation.

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

5.6 Materials Disposal Offsite

If deemed necessary, excavated material will be removed from the Site and disposed of in accordance with regulatory requirements based on the levels of contamination found to be present in waste characterization samples collected.

The following documentation will be obtained and reported for each disposal location used in this project to demonstrate and document that the disposal of material derived from the Site conforms with all applicable laws: (1) a letter or facility-specific waste profile/application from the Environmental Consultant or the Applicant to the receiving facility describing the material to be disposed and requesting formal written acceptance of the material. This letter/profile/application will state that material to be disposed is contaminated material generated at an environmental remediation Site in New York State. The letter will provide the project identity and the name and phone number of the Environmental Consultant or the Applicant. The letter will include as an attachment a summary of all chemical data for the material being transported (including Site characterization data); and (2) a letter from all receiving facilities stating it is in receipt of the correspondence (above) and is approved to accept the material. These documents will be included in the Final Engineering Report (FER) following approval of the Remedial Action Work Plan and completion of the final remedy.

The FER will include an accounting of the destination of all material removed from the Site during this IRM. This information will also be presented in a tabular form in the FER.

A Bill of Lading system or equivalent will be used for offsite movement of non-hazardous wastes and contaminated soils. This information will be reported in the FER.

Hazardous wastes derived from onsite will be stored, transported, and disposed of in compliance with applicable local, State, and Federal regulations.

Appropriately licensed haulers will be used for material removed from this Site and will be in compliance with all applicable local, State and Federal regulations.

Waste characterization will be performed for offsite disposal in a manner suitable to the receiving facility and in conformance with applicable permits. All data available for soil/material to be disposed at a given facility must be submitted to the disposal facility with suitable explanation prior to shipment and receipt.

5.7 Materials Reuse Onsite

Onsite reuse of soil is not anticipated as part of this IRMWP scope of work. Consistent with NYSDEC DER-31 Green Remediation practices, recognizable and uncontaminated building demolition debris (i.e., brick or concrete) generated during building demolition and limited removal of subgrade features will be reused onsite, as appropriate, following completion of the ACM abatement and provided no evidence of impacts or gross contamination is observed (staining, odors, PID responses). “Reuse onsite” means material does not leave the property, and is put at a level at least one foot above the seasonal high water table. The Environmental Consultant will confirm that materials proposed for reuse are segregated from other materials to be exported from the Site and that procedures defined for material reuse in this SoMP are followed.

A Request to Import/Reuse Fill or Soil form, or Case-Specific Beneficial Use Determination form, if applicable, will be submitted to NYSDEC for review and approval prior to onsite reuse of building demolition debris. Onsite reuse of soil is not anticipated, however if deemed necessary soil may be reused onsite in accordance with the guidelines described in DER-10 Section 5.4(e) and following NYSDEC approval. Soil or historic fill excavated from the Site during the IRM will not be reused within a final cover soil layer or within landscaping berms, if applicable.

Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the Site is prohibited for reuse onsite.

5.8 Fluids Management

All liquids to be removed from the Site will be handled, transported, and disposed in accordance with applicable laws and regulations. If any USTs are encountered, all liquids observed in the USTs will be removed prior to closure. All liquids removed from the USTs will be sampled in a manner required by the receiving facility and in compliance with applicable laws and regulations. Liquid waste manifests will be reported to NYSDEC in the FER.

Any accumulated stormwater and/or groundwater encountered during the IRM will be managed and discharged under the appropriate New York City permit and will follow all local, state, and federal regulations.

5.9 Backfill from Offsite Sources

All materials proposed for import onto the Site will be approved by the Environmental Consultant and will be in compliance with provisions in this IRM prior to receipt at the Site.

Material from industrial sites, spill sites, other environmental remediation sites or other potentially contaminated sites will not be imported to the Site. Solid waste will not be imported onto the Site.

All imported soils will meet NYSDEC-approved backfill or cover soil quality objectives for this Site. These NYSDEC approved backfill or cover soil quality objectives are the lower of the Protection of Groundwater or the protection of public health soil cleanup objectives for Industrial or higher use as set forth in Table 375-6.8(b) of 6 NYCRR Part 375. Non-compliant soils will not be imported onto the Site without prior approval by NYSDEC. Nothing in the approved IRM or its approval by NYSDEC should be construed as an approval for this purpose.

Soils that meet ‘exempt’ fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC. Nothing in this IRM should be construed as an approval for this purpose.

In accordance with DER-10, the following material may be imported, without chemical testing, to be used as backfill beneath pavement, buildings or as part of the final site cover, provided that it contains less than 10% by weight material which would pass through a size 80 sieve and consists of:

- gravel, rock, or stone, consisting of virgin material from a NYSDEC permitted mine or quarry; or
- recycled concrete or brick from a NYSDEC registered construction and demolition debris processing facility if the material conforms to the requirements of Section 304 of the New York State Department of Transportation *Standard Specifications Construction and Materials Volume 1* (2002).

Trucks entering the Site with imported soils will be securely covered with tight fitting covers.

5.10 Stormwater Pollution Prevention

Applicable laws and regulations pertaining to stormwater pollution prevention will be addressed during the IRM activities. It is anticipated that a SWPPP will be prepared in conjunction with the attainment of a General Permit for the entirety of the Site prior to start of the IRM activities. Erosion and sediment control measures (silt fences and/or barriers, and/or hay bale checks) will be installed, as appropriate, around the entire perimeter of the remedial construction area and inspected once a week and after every storm event to ensure that they are operating appropriately. Discharge locations, if any, will be inspected to determine whether erosion control measures are effective in preventing significant impacts to receptors. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All necessary repairs to erosion and sediment controls shall be made immediately. Accumulated sediments will be removed as required to keep the barrier and hay bale check functional. Undercutting or erosion of the silt fence anchor will be repaired immediately with appropriate backfill materials. Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

5.11 Community Air Monitoring Plan

The Environmental Consultant will implement the CAMP during any intrusive subsurface activities to conduct monitoring and protection for potential offsite receptors. CAMP will not be implemented during building demolition until building slabs are removed and underlying Site soil is exposed. The CAMP scope of work will include the use of one downwind air monitoring station and one upwind air monitoring station each equipped with one PID and one particulate meter. Upwind concentrations will be measured at the start of each workday and periodically throughout the day to establish background concentrations. Daily reporting of any exceedances will be provided to the NYSDEC and NYSDOH. The results of the CAMP data will be provided to the NYSDEC and NYSDOH on a weekly basis. CAMP data results will be provided in the final RIR along with locations of perimeter monitoring stations, monitoring equipment, procedures, and contaminant action levels. The CAMP is included as Appendix C of this RIWP/IRMWP.

5.12 Odor, Dust, and Nuisance Control Plan

5.12.1 Odor Control Plan

In addition to the CAMP monitoring (included as Appendix C), the Environmental Consultant will closely monitor the presence of any odors emanating from either excavation or stockpiles.

Odor controls will be employed to prevent on and offsite odor nuisances. At a minimum, procedures will include: (a) limiting the area of open excavations; (b) shrouding open excavations with tarps and other covers; and (c) use of odor suppressants to cover exposed odorous soils. If nuisance odors develop and cannot otherwise be controlled, additional means to eliminate them will include: (d) direct load-out of soils to trucks for offsite disposal; and (e) use of chemical odorants in spray or misting systems.

This odor control plan is capable of controlling emissions of nuisance odors. If nuisance odors are identified, the source of odors will be identified and corrected. If necessary, to identify or correct a nuisance odor source, work will be temporarily halted and will not resume until such nuisance odors have been identified and abated. NYSDEC will be notified of all odor complaint events.

5.12.2 Dust Control Plan

Dust management during invasive onsite work will include, at a minimum:

- Use of properly anchored tarps to cover stockpiles;
- Exercising extra care during dry and high-wind periods; and
- Dust suppression will be achieved through the use of water for wetting excavation areas, as necessary. Water will be available onsite at suitable supply and pressure for use in dust control.

This dust control plan is capable of controlling emissions of dust. If nuisance dust emissions are identified, work will be halted, and the source of dusts will be identified and corrected. Work will not resume until all nuisance dust emissions have been abated. NYSDEC will be notified of all dust complaint events.

5.12.3 Other Nuisances

Noise control will be exercised during the remedial program. All remedial work will conform, at a minimum, to NYC noise control standards. Rodent control will be provided during building demolition and during the remedial program, as necessary, to prevent nuisances.

6. Reporting and Schedule

The Environmental Consultant and the Applicant will commence implementation of this RIWP/IRMWP following the receipt of NYSDEC's written approval. The Environmental Consultant will notify NYSDEC no less than seven days in advance of implementation of the RIWP, unless NYSDEC agrees to a shorter period in writing. The Environmental Consultant will also provide NYSDEC notice as to any change in the approved project schedule. The following will be provided to the NYSDEC during the course of the RI work.

Daily Reports

Daily report submittals to be provided to the NYSDEC and NYSDOH during intrusive activities only during the RI and IRM and will include the following.

- A summary of onsite work completed and summary tables of the CAMP monitoring data will be submitted to NYSDEC on a daily basis;
- NYSDEC and NYSDOH will be notified immediately (within 24 hours) of any CAMP exceedances and corrective actions taken;
- Discovery of any previously unknown contaminated media during RI and IRM activities will be promptly communicated to NYSDEC's project manager; and
- A Site map will be provided to identify locations discussed in progress reports provided to NYSDEC.

Monthly Reports

Monthly reports will be submitted to NYSDEC and NYSDOH Project Managers during intrusive activities only. Monthly reports will be submitted within one week following the end of the month of the reporting period and will include:

- Activities relative to the Site during the previous reporting period and those anticipated for the next reporting period, including a quantitative presentation of work performed (i.e., tons of material exported and imported, etc.);
- Description of approved activity modifications, including changes of work scope and/or schedule;
- Sampling results received following internal data review and validation, as applicable; and
- An update of the remedial schedule including the percentage of project completion, unresolved delays encountered or anticipated that may affect the future schedule, and efforts made to mitigate such delays.

Final RIWP/IRMWP Reporting

Following the completion of the RI, a RIR will be prepared to summarize the results and findings of the RI. The RIR will likely be combined with the RAWP into a single RIR/RAWP due to project construction timeline constraints. The RIR/RAWP will include all data developed during the RI and will meet the technical requirements of DER-10.

Upon receipt of the indoor air data collected from buildings 57 and 58 as part of the RI, the data will be shared and discussed with NYSDEC and NYSDOH. If any further notifications will be discussed with NYSDEC and NYSDOH at that time.

All work completed as part of the IRM portion of this work plan will be summarized in an IRM section of the FER and will include disposal approval letters, soil, and water disposal bill of ladings, as applicable, and a detailed summary of all work completed in accordance with the IRMWP.

RIWP/IRMWP Implementation Schedule

Remedial Investigation Schedule	
Submit BCP Application and RIWP	June 2021
Volunteer and NYSDEC Sign BCA; Submit Citizen Participation Plan (CPP)	September 2021
Approval and Implementation of RIWP/IRMWP	October 2021
SVI Sampling of Buildings 57 and 58	November/December 2021
Unit G Demolition	December 2021
Submit RIR/RAWP and Fact Sheet	December 2021
NYSDEC and NYSDOH Approval of RIR/RAWP	March 2022
Begin Implementation of RAWP	March 2022

7. References

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

G.C. Environmental, Inc., November 25, 2013. Remedial Investigation Report.

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

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

NYSDEC, January 2021. Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC’s Part 375 Remedial Programs.

TRC Engineers, Inc., December 17, 2019. Phase I Environmental Site Assessment.

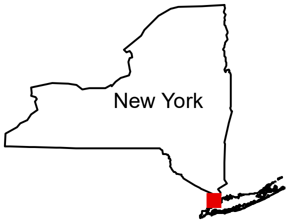
TRC Engineers, Inc., May 2020. Phase II Environmental Site Investigation Report.

TRC Engineers, Inc., October 6, 2020. Supplemental Phase II Environmental Site Investigation Summary Report.

Remedial Investigation Work Plan/
Interim Remedial Measures Work Plan
5000 1st Avenue, Brooklyn, New York

FIGURES

QUADRANGLE LOCATION



N

1,000 0 1,000'

Title:

SITE LOCATION MAP

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL LLC

ROUX

Compiled by: P.K.	Date: 05/14/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	1
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y100.1.mxd		

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LEGEND

🟥 BCP SITE BOUNDARY

☐ LOT BOUNDARY

775 200	BLOCK LOT

NOTE

1. SOURCE - NEW YORK CITY DEPARTMENT OF INFORMATION AND TECHNOLOGY

200 0 200'

Title:

TAX MAP

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL LLC

ROUX

Compiled by: P.K.	Date: 05/14/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	2
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y100.2.mxd		

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LEGEND

▭	BCP SITE BOUNDARY
▭	LOT BOUNDARY
775 200	BLOCK LOT

NOTE

1. SOURCE - NEW YORK CITY DEPARTMENT OF INFORMATION AND TECHNOLOGY

200 0 200'

Title:

EXISTING CONDITIONS

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL LLC

ROUX

Compiled by: P.K.	Date: 05/14/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	3
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y100.3.mxd		

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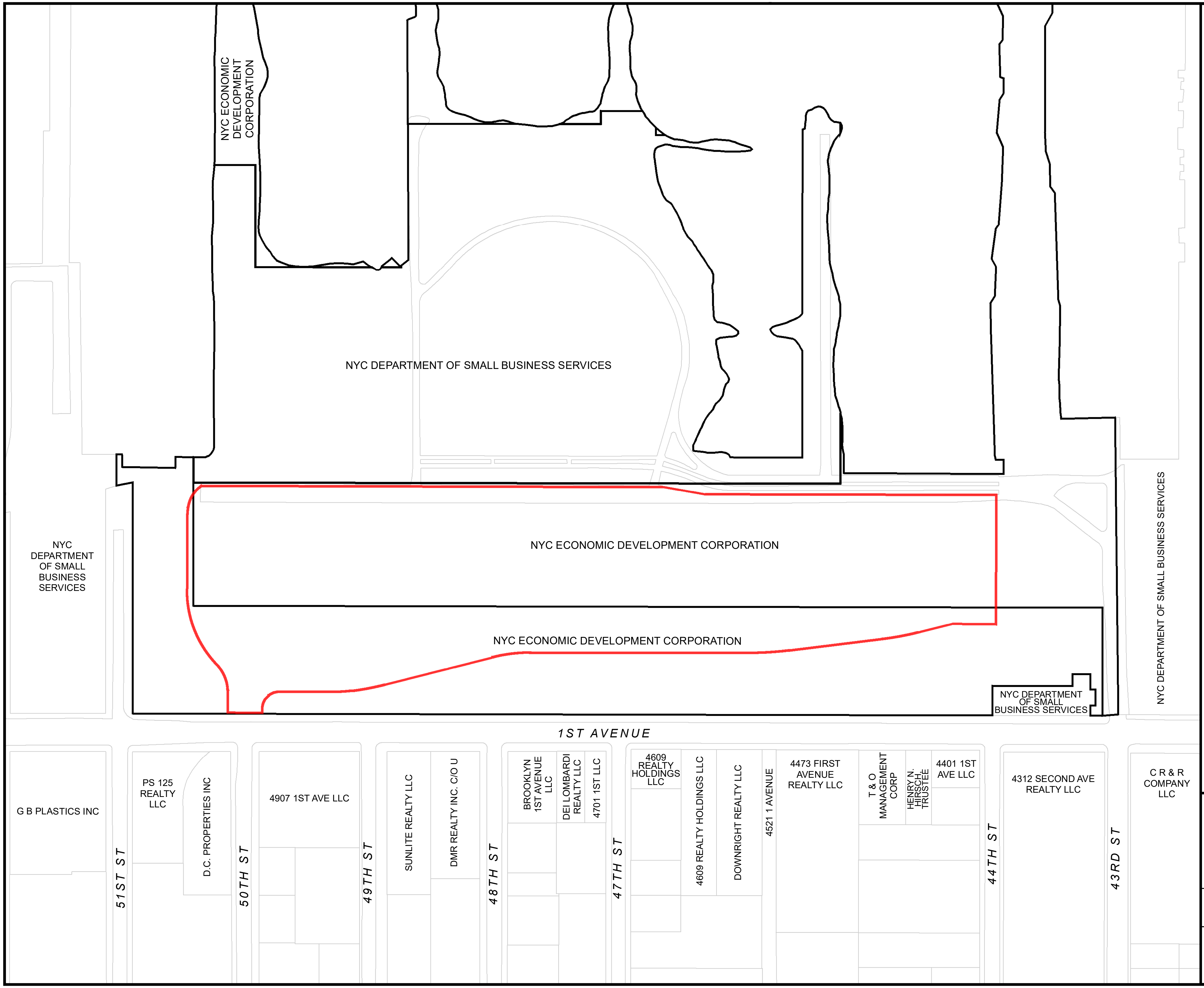

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LEGEND

🟥 BCP SITE BOUNDARY

▭ LOT BOUNDARY

NOTE

1. SOURCE - NEW YORK CITY DEPARTMENT OF INFORMATION AND TECHNOLOGY

200 0 200'

Title:

ADJACENT PROPERTY OWNERS

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL LLC

ROUX

Compiled by: P.K.	Date: 05/17/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	4
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y100.4.mxd		

ABBREVIATIONS

ASPH	ASPHALT
BOT	BOTTOM
BS	BLUE STRIPING
BSMT	BASEMENT
CC	CONCRETE CURB
CLF	CHAIN LINK FENCE
COL	COLUMN
CONC	CONCRETE
DC	DEPRESSED CURB
DWL	DASHED WHITE LINE
DWP	DETECTABLE WARNING PAD
ELEC	ELECTRIC
EOP	EDGE OF PAVEMENT
FWD	FILLED WITH DIRT/DEBRIS
FWW	FILLED WITH WATER
GC	GARBAGE CAN
GM	GAS METER
GRT	GRATE
IF	IRON FENCE
JB	JUNCTION BOX
INV	INVERT
LP	LIGHT POLE
LSA	LANDSCAPED AREA
MC	METAL COVER
MG	METAL GRATE
MR	METAL RAILING
NPV	NO PIPES VISIBLE
OH	OVERHEAD
PLNTR	PLANTER
PVMT	PAVEMENT
(R)	UTILITY INFORMATION DERIVED FROM REFERENCE MAPPING
RDSG	ROLL DOWN SECURITY GATE
RR	RAIL ROAD
SB	STOP BAR
SFCC	STEEL FACED CONCRETE CURB
TELE	TELEPHONE
(TYP)	TYPICAL
UTIL	UTILITY
UTO	UTO
WL	WHITE LINE
WS	WHITE STRIPING
X-WALK	CROSSWALK
YL	YELLOW LINE

MAP LEGEND

— · — · —	PROPOSED PREMISE LINE
—— — — ——	TAX LOT LINE
🟩	"PROPOSED BCP BOUNDARY" 598,647.18 S.F. OR 13.743 ACRES
/ / / / /	BUILDING FOOTPRINT & DOORWAY AT GROUND LEVEL
— — —14— — —	EXISTING CONTOUR
x 14.34	EXISTING SPOT ELEVATION
x TC 14.34	EXIST. TOP OF CURB ELEVATION
x BC 14.34	EXIST. GUTTER ELEVATION
x TW 14.34	EXIST. TOP OF WALL ELEVATION
x BW 14.34	EXIST. BOTTOM OF WALL ELEVATION
x FF 14.34	FINISHED FLOOR ELEVATION
x DS 14.34	DOOR SILL ELEVATION
HYD	HYDRANT
W ☐	WATER VALVE
G ☐	GAS VALVE
V ☐	UNIDENTIFIED VALVE
——OH——	OVERHEAD WIRES
——X——	EXISTING FENCE
— — W 12"W —	APPROX. LOC. UNDERGROUND WATER LINE & SIZE PER REFERENCE MAPPING & MASTER LOCATORS MARKOUT
— — G — —	APPROX. LOC. UNDERGROUND GAS LINE PER REFERENCE MAPPING & MASTER LOCATORS MARKOUT
— — E — —	APPROX. LOC. UNDERGROUND ELECTRIC LINE PER REFERENCE MAPPING & MASTER LOCATORS MARKOUT
— — T — —	APPROX. LOC. UNDERGROUND TELEPHONE LINE PER REFERENCE MAPPING & UTILITY MARKOUT
— — C — —	APPROX. LOC. UNDERGROUND COMMUNICATION LINE COMMUNICATION LINE PER REFERENCE MAPPING
— — S — —	APPROX. LOC. UNDERGROUND SAN. SEWER PER REFERENCE MAPPING & MASTER LOCATORS MARKOUT
— — ST — —	APPROX. LOC. UNDERGROUND STORM SEWER LINE PER REFERENCE MAPPING & MASTER LOCATORS MARKOUT
— — F — —	APPROX. LOC. UNDERGROUND FDNY COMMUNICATION LINE PER REFERENCE MAPPING
4	PARKING SPACE COUNT
AL	AREA LIGHT
MH ●	MANHOLE
▤	INLET
UP ∅	UTILITY POLE
UP/LP	UTILITY POLE/LIGHT POLE
LP	LIGHT POLE
BOL ●	BOLLARD
	SIGN
COND ○	CONDUIT
PIV ○	POST INDICATOR VALVE
FDC	FIRE DEPARTMENT CONNECTION
1.0'	DENOTES OFFSET OF STRUCTURE AT GROUND LEVEL RELATIVE TO PROPERTY LINE
4"	DENOTES TREE AND TRUNK DIAMETER
37.25' T.M.	DISTANCE BASED ON TAX MAP
SB PK NAIL 8147 7.41 ◉	SOIL BORING LOCATION WITH DESIGNATION & ELEVATION
BENCHMARK X-CUT ON CURB ELEV: 9.77	SITE BENCHMARK WITH DESCRIPTION & ELEVATION

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

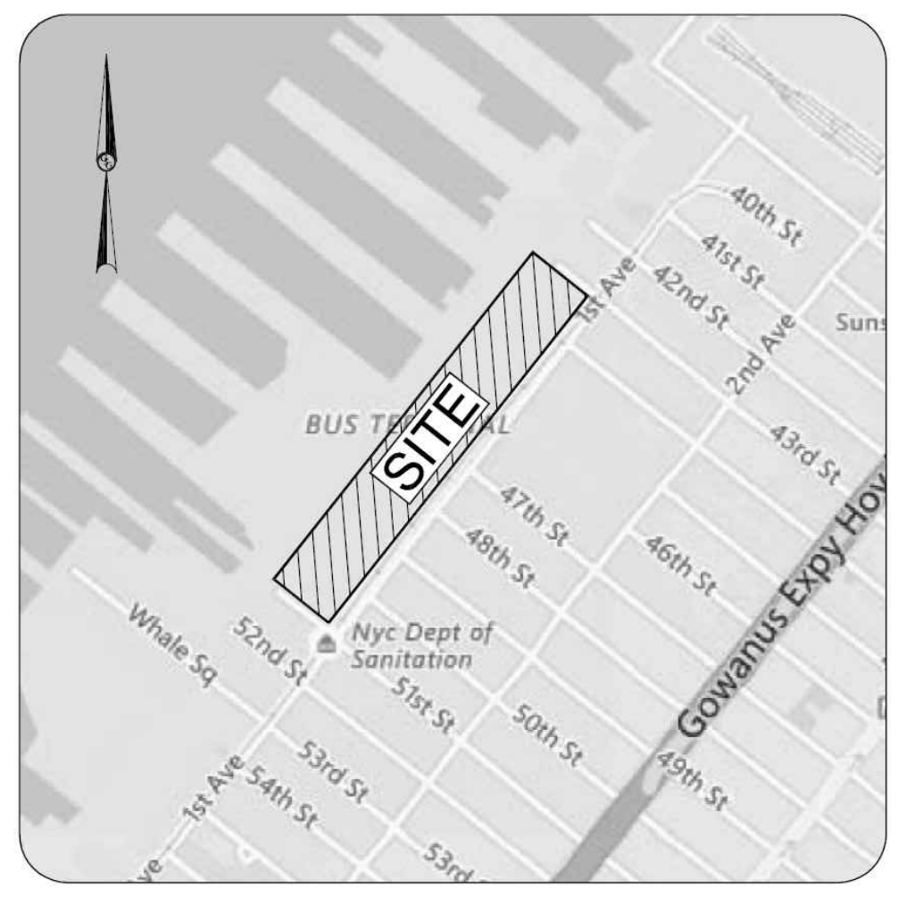
STATION ID: 8518750
PUBLICATION DATE: 04/21/2003
NAME: THE BATTERY, NEW YORK HARBOR

TIDAL DATUMS AT THE BATTERY, NEW YORK HARBOR BASED ON:
LENGTH OF SERIES: 19 YEARS
TIME PERIOD: JANUARY 1983 - DECEMBER 2001
TIDAL EPOCH: 1983-2001

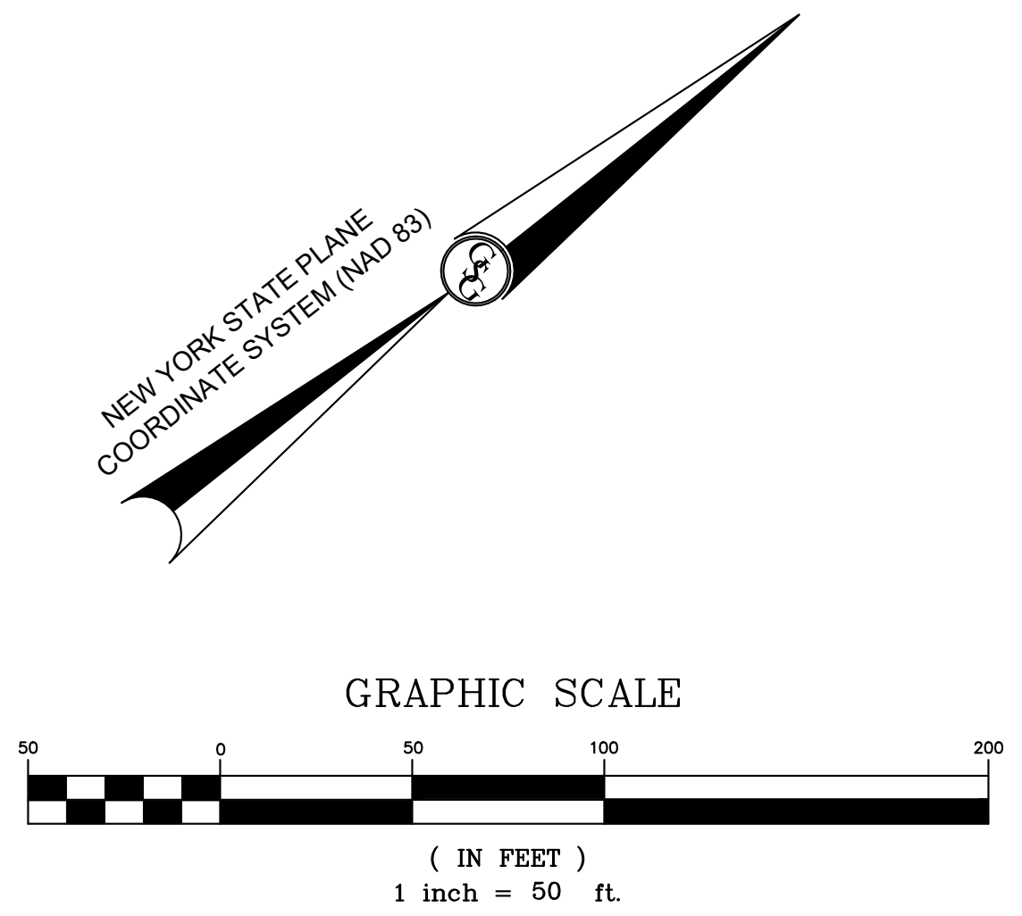
ELEVATIONS OF TIDAL DATUMS REFERRED TO MEAN LOWER LOW WATER (MLLW):

	METERS (MLLW)	FEET (MLLW)	NAVD 88 (FEET)
MEAN HIGHER HIGH WATER (MHHW)	1.541	5.056	2.280
MEAN HIGH WATER (MHW)	1.443	4.734	1.958
NAVD 88	0.846	2.776	0.00
MEAN SEA LEVEL	0.783	2.569	-0.207
MEAN TIDE LEVEL	0.753	2.470	-0.306
MEAN LOW WATER (MLW)	0.063	0.207	-2.569
MEAN LOWER LOW WATER (MLLW)	0.00	0.00	-2.776

NOTE: THIS CHART REPRESENTS THE NEAREST TIDAL BENCHMARK TO THE SURVEYED SITE. THE TIDE ELEVATIONS AT THIS SITE THAT WAS SURVEYED MAY BE SUBJECT TO DIFFERENT ELEVATIONS.



VICINITY MAP



Title:

SITE SURVEY AND BROWNFIELD CLEANUP PROGRAM BOUNDARY

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL, LLC

ROUX

Compiled by: L.D.	Date: 16APR21	FIGURE
Prepared by: B.H.C.	Scale: AS SHOWN	5
Project Mgr: L.D.	Project: 3454.0001Y002	
File: 3454.0001Y105.01.DWG		

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TRC-SB-12	3/4/2020
Depth (ft bls)	0 - 2
SVOCs	
Benzo(a)anthracene	8.6
Benzo(a)pyrene	8.3
Benzo(b)fluoranthene	10
Benzo(k)fluoranthene	3.1
Chrysene	8.4
Dibenz(a,h)anthracene	1.1
Indeno(1,2,3-cd)pyrene	4.1
Metals	
Arsenic	120
Copper	260
Lead	310
Mercury	0.42
Zinc	660
Pesticides	
4,4'-DDE	0.13
4,4'-DDT	0.69
4,4'-DDD	0.22

SB-13	10/11/2013
Depth (ft bls)	0 - 2
Metals	
Mercury	0.19

SB-8	10/9/2013	10/9/2013
Depth (ft bls)	0 - 2	7 - 10
Metals		
Lead	NE	75.9
Mercury	0.29	0.44
Pesticides		
Dieldrin	0.0097	NE

TRC-SB-23	3/10/2020
Depth (ft bls)	7 - 9
Metals	
Nickel	130

SB-7	10/11/2013
Depth (ft bls)	0 - 2
Metals	
Nickel	32.7

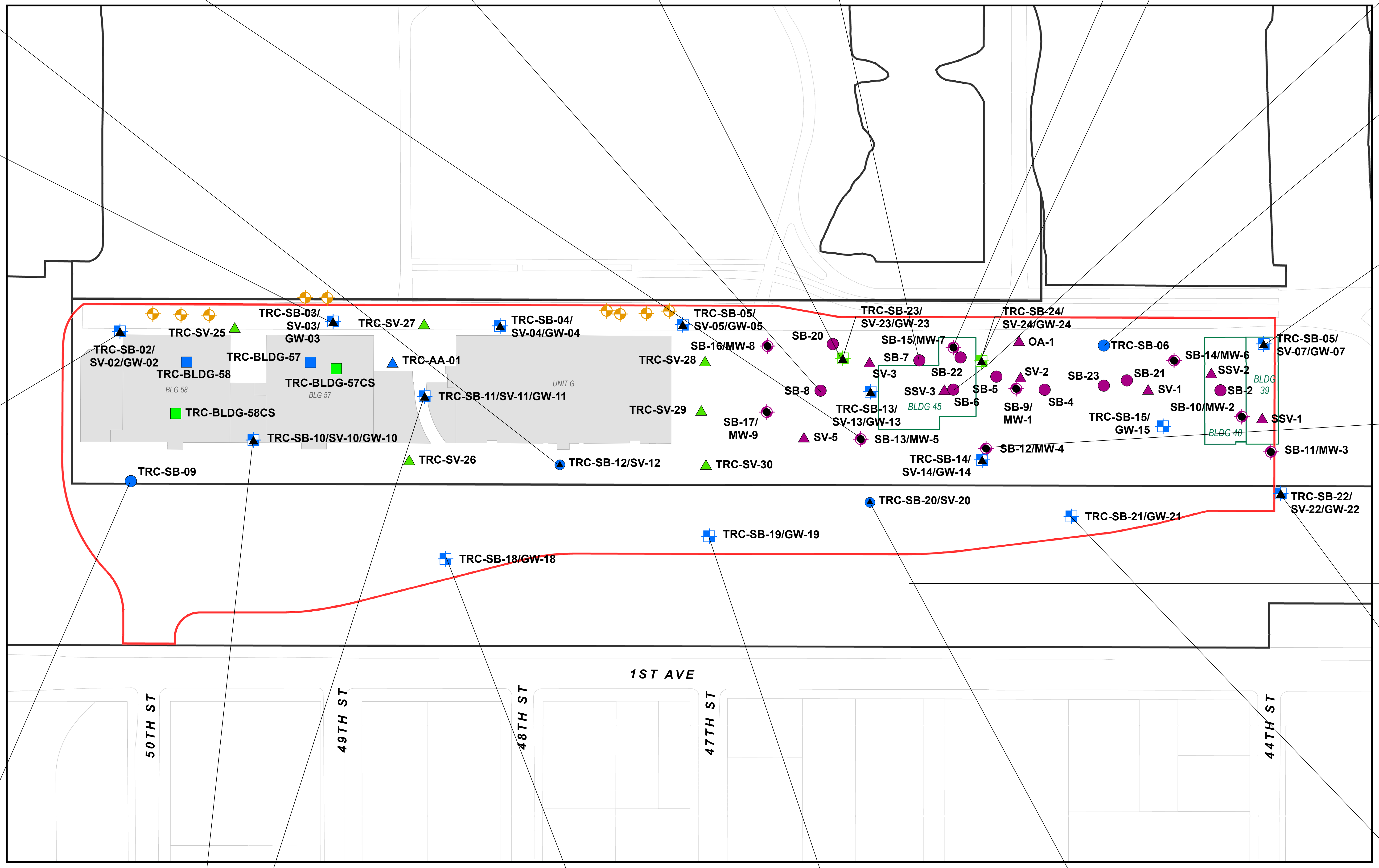
SB-15	10/14/2013	10/14/2013
Depth (ft bls)	0 - 2	5 - 10
Metals		
Lead	71.2	NE
Mercury	0.25	ND
Nickel	NE	65.8
Polychlorinated Biphenyl (PCBs)		
Total PCBs	0.28	NE

TRC-SB-24	3/10/2020	3/10/2020
Depth (ft bls)	0 - 2	3 - 5
Metals		
Zinc	260	110

SB-6	10/14/2013	10/14/2013
Depth (ft bls)	0 - 2	0 - 2 DUP
Metals		
Chromium (Total)	NE	48.1
Lead	NE	109
Mercury	0.19	0.23

TRC-SB-03	3/5/2020	3/5/2020
Depth (ft bls)	0 - 2	5 - 7
SVOCs		
Benzo(a)anthracene	NE	6.8
Benzo(a)pyrene	NE	5.8
Benzo(b)fluoranthene	NE	7.5
Benzo(k)fluoranthene	NE	2.5
Chrysene	NE	6
Dibenz(a,h)anthracene	ND	0.8
Indeno(1,2,3-cd)pyrene	NE	3.1
Metals		
Lead	84	NE
Nickel	51	NE
Zinc	310	NE

TRC-SB-02	3/5/2020	3/5/2020
Depth (ft bls)	0 - 2	4 - 6
SVOCs		
Benzo(a)anthracene	5	11
Benzo(a)pyrene	7.4	8.7
Benzo(b)fluoranthene	9	12
Benzo(k)fluoranthene	2.4	3.7
Chrysene	5.1	9.2
Dibenz(a,h)anthracene	1.4	1.2
Indeno(1,2,3-cd)pyrene	5.7	3.6
Metals		
Beryllium	8.6	NE
Copper	360	58
Lead	650	360
Mercury	1.1	0.92
Nickel	170	NE
Zinc	2000	380
Polychlorinated Biphenyl (PCBs)		
Total PCBs	0.29	0.18
Pesticides		
4,4'-DDE	ND	0.014
4,4'-DDT	ND	0.03



TRC-SB-06	3/6/2020
Depth (ft bls)	0 - 2
Metals	
Lead	65

SB-5	10/14/2013	10/14/2013
Depth (ft bls)	0 - 2	5 - 10
Metals		
Lead	74.8	NE
Zinc	125	119
Polychlorinated Biphenyl (PCBs)		
Total PCBs	0.14	ND

SB-12	10/14/2013
Depth (ft bls)	0 - 2
Metals	
Chromium (Total)	36.8
Copper	66.2
Lead	83.7
Nickel	55.7
Zinc	148

TRC-SB-14	3/6/2020
Depth (ft bls)	4 - 6
SVOCs	
Benzo(a)anthracene	1.4
Benzo(a)pyrene	1.3
Benzo(b)fluoranthene	1.8
Chrysene	1.1
Indeno(1,2,3-cd)pyrene	0.53
Metals	
Arsenic	27
Polychlorinated Biphenyl (PCBs)	
Total PCBs	0.21

TRC-SB-22	3/9/2020
Depth (ft bls)	0 - 2
Metals	
Arsenic	66
Copper	220
Lead	290
Mercury	0.21
Nickel	34
Zinc	150

TRC-SB-09	3/3/2020	3/3/2020
Depth (ft bls)	0 - 2	4 - 6
SVOCs		
Benzo(a)anthracene	44	ND
Benzo(a)pyrene	43	ND
Benzo(b)fluoranthene	51	ND
Benzo(k)fluoranthene	15	ND
Chrysene	42	ND
Dibenz(a,h)anthracene	6.1	ND
Indeno(1,2,3-cd)pyrene	21	ND
Metals		
Copper	310	NE
Lead	690	NE
Mercury	1.1	ND
Nickel	NE	33
Zinc	280	NE

TRC-SB-10	3/4/2020
Depth (fb bls)	0 - 2
SVOCs	
Benzo(a)anthracene	1.3
Benzo(a)pyrene	1.2
Benzo(b)fluoranthene	1.9
Chrysene	1.4
Indeno(1,2,3-cd)pyrene	0.68
Metals	
Arsenic	190
Copper	83
Lead	200
Mercury	0.26
Zinc	160
Polychlorinated Biphenyl (PCBs)	
Total PCBs	0.84

TRC-SB-11	3/5/2020	3/5/2020
Depth (ft bls)	0 - 2	4 - 6
SVOCs		
Benzo(a)anthracene	4.5	NE
Benzo(a)pyrene	4.1	NE
Benzo(b)fluoranthene	5.3	NE
Benzo(k)fluoranthene	1.7	NE
Chrysene	4.2	NE
Dibenz(a,h)anthracene	0.63	NE
Metals		
Arsenic	50	31
Copper	52	73
Lead	130	630
Mercury	0.3	0.63
Zinc	140	390
Polychlorinated Biphenyl (PCBs)		
Total PCBs	0.58	ND
Pesticides		
4,4'-DDE	0.027	ND
4,4'-DDT	0.082	ND
4,4'-DDD	0.15	ND

TRC-SB-18	3/4/2020
Depth (ft bls)	0 - 2
Pesticides	
4,4'-DDD	0.016

TRC-SB-19	3/4/2020
Depth (ft bls)	0 - 2
SVOCs	
Acenaphthene	53
Benzo(a)anthracene	15
Benzo(a)pyrene	7.9
Benzo(b)fluoranthene	11
Benzo(k)fluoranthene	4.2
Chrysene	13
Dibenzofuran	37
Fluorene	58
Indeno(1,2,3-cd)pyrene	3.5
Naphthalene	54
Phenanthrene	170
Metals	
Arsenic	25
Chromium (Total)	39
Copper	160
Lead	110
Nickel	33
Zinc	110
Polychlorinated Biphenyl (PCBs)	
Total PCBs	0.33

TRC-SB-20	3/9/2020	3/9/2020	3/9/2020
Depth (ft bls)	0 - 2	0 - 2 DUP	6 - 8
SVOCs			
Benzo(a)anthracene	2.1	2.8	ND
Benzo(a)pyrene	2.1	3.1	ND
Benzo(b)fluoranthene	3.6	6.1	ND
Benzo(k)fluoranthene	0.96	1.7	ND
Chrysene	2.3	3.2	ND
Dibenz(a,h)anthracene	ND	0.55	ND
Indeno(1,2,3-cd)pyrene	1.1	1.8	ND
Metals			
Arsenic	NE	210	NE
Copper	150	330	NE
Lead	210	390	NE
Mercury	0.23	0.7	ND
Zinc	540	180	280
Polychlorinated Biphenyl (PCBs)			
Total PCBs	0.14	0.12	ND
Pesticides			
4,4'-DDE	0.043	0.025	ND
4,4'-DDT	0.085	0.05	ND
4,4'-DDD	0.04	0.046	ND

TRC-SB-21	3/9/2020	3/9/2020
Depth (ft bls)	0 - 2	6 - 8
SVOCs		
Benzo(a)anthracene	1.6	NE
Benzo(a)pyrene	1.2	NE
Benzo(b)fluoranthene	1.6	NE
Chrysene	1.5	NE
Polychlorinated Biphenyl (PCBs)		
Total PCBs	0.42	13

LEGEND

- ⊕ LOCATION OF EXISTING MONITORING WELL
- ⊕ LOCATION OF MONITORING WELL, TRC PHASE II 2020
- ● LOCATION OF SOIL BORING, TRC PHASE II 2020
- ▣ LOCATION OF SOIL BORING AND TEMPORARY MONITORING WELL, TRC PHASE II 2020
- ▲ LOCATION OF SOIL BORING, SOIL VAPOR POINT, AND TEMPORARY MONITORING WELL, TRC PHASE II 2020
- ▲ LOCATION OF SOIL BORING AND SOIL VAPOR POINT, TRC PHASE II 2020
- ▲ LOCATION OF AMBIENT AIR SAMPLE, TRC PHASE II 2020
- ■ LOCATION OF INDOOR AIR SAMPLE, TRC PHASE II 2020
- ● LOCATION OF SOIL BORING, GCE RI 2013
- ⊙ LOCATION OF SOIL BORING AND MONITORING WELL, GCE RI 2013
- ▲ LOCATION OF VAPOR INTRUSION SAMPLE, GCE RI 2013

SV - SOIL VAPOR SAMPLING LOCATION
SSV - SUB-SLAB SOIL VAPOR SAMPLING LOCATION
OA - OUTDOOR AIR SAMPLING LOCATION

- ▲ LOCATION OF SOIL BORING, SOIL VAPOR POINT, AND TEMPORARY MONITORING WELL, TRC SUPPLEMENTAL PHASE II ESA, 2020
- ▲ LOCATION OF AMBIENT AIR SAMPLE, TRC SUPPLEMENTAL PHASE II ESA, 2020
- 🟩 LOCATION OF INDOOR AIR SAMPLE, TRC SUPPLEMENTAL PHASE II ESA, 2020
- 🟥 BCP SITE BOUNDARY
- ▭ APPROXIMATE LOCATION OF FORMER BUILDINGS DEMOLISHED IN 2015
- ▨ LOCATION OF EXISTING BUILDING
- ▭ LOT BOUNDARY

Parameter	NYSDEC Part 375 Unrestricted Use SCO	NYSDEC Part 375 Protection of Groundwater SCO	NYSDEC Part 375 Industrial Use SCO
VOCs	NE	NE	NE
SVOCs			
Acenaphthene	20	98	1000
Benzo(a)anthracene	1	1	11
Benzo(a)pyrene	1	22	1.1
Benzo(b)fluoranthene	1	1.7	11
Benzo(k)fluoranthene	0.8	1.7	110
Chrysene	1	1	110
Dibenzofuran	7	210	1000
Dibenz(a,h)anthracene	0.33	1000	1.1
Fluorene	30	386	1000
Indeno(1,2,3-cd)pyrene	0.5	8.2	11
Naphthalene	12	12	1000
Phenanthrene	100	1000	1000
Metals			
Arsenic	13	16	16
Beryllium	7.2	47	2700
Chromium (Total)	30	NS	6800
Copper	50	1720	10000
Lead	63	450	3900
Mercury	0.18	1	6
Nickel	30	130	10000
Zinc	109	2480	10000
Polychlorinated Biphenyl (PCBs)			
Total PCBs	0.1	3.2	25
Pesticides			
Dieldrin	0.005	0.1	3
4,4'-DDE	0.0033	17	120
4,4'-DDT	0.0033	136	94
4,4'-DDD	0.0033	14	180

NOTES

1. ALL CONCENTRATIONS SHOWN IN MILLIGRAMS PER KILOGRAM
2. BOLD DATA INDICATES THAT PARAMETER WAS DETECTED ABOVE THE NYSDEC PART 375 UNRESTRICTED USE SCO
3. RED DATA INDICATES THAT PARAMETER WAS DETECTED ABOVE THE NYSDEC PROTECTION OF GROUNDWATER SCO
4. SHADED DATA INDICATES THAT PARAMETER WAS DETECTED ABOVE THE NYSDEC PART 375 INDUSTRIAL SCO

DUP - DUPLICATE SAMPLE
FT BLS - FEET BELOW LAND SURFACE
ND - NOT DETECTED
NE - NO EXCEEDANCE
NS - NO STANDARD
NYSDEC - NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
PCBS - POLYCHLORINATED BIPHENYLS
SCO - SOIL CLEANUP OBJECTIVE
SVOCS - SEMIVOLATILE ORGANIC COMPOUNDS
VOCS - VOLATILE ORGANIC COMPOUNDS

100 0 100'

Title:

SUMMARY OF EXCEEDANCES IN SOIL

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL LLC

ROUX

Compiled by: P.K.	Date: 05/14/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	6
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y100.6.mxd		

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MW-9	10/7/2013
SVOCs	
Benzo(a)anthrancene	**0.021**
Metals, Filtered	
Antimony	**6**
Iron	**2530**
Manganese	**1010**
Sodium	**152000**

TRC-GW-05	3/5/2020
Metals, Total	
Antimony	**6.3**
Iron	**22000**
Manganese	**420**
Sodium	**95000**
Metals, Filtered	
Antimony	**5.5**
Iron	**430**
Sodium	**110000**

MW-8	10/9/2013
SVOCs	
Benzo(a)anthrancene	**0.03**
Metals, Filtered	
Antimony	**7**
Iron	**5100**
Lead	**56**
Manganese	**1390**
Sodium	**126000**

TRC-GW-23	3/10/2020
Metals, Total	
Manganese	**350**
Metals, Filtered	
Manganese	**370**

TRC-GW-13	3/9/2020
Metals, Total	
Chromium (Total)	**110**
Iron	**110000**
Lead	**59**
Manganese	**2400**
Sodium	**82000**
Metals, Filtered	
Manganese	**970**
Sodium	**85000**

MW-7	10/15/2013
SVOCs	
Benzo(a)anthrancene	**0.22**
Benzo(a)pyrene	**0.15**
Benzo(b)fluoranthene	**0.26**
Benzo(k)fluoranthene	**0.07**
Chrysene	**0.21**
Indeno(1,2,3-cd)pyrene	**0.08**
Metals, Filtered	
Iron	**9580**
Lead	**515**
Manganese	**2390**
Sodium	**221000**
Pesticides	
Dieldrin	**0.006**

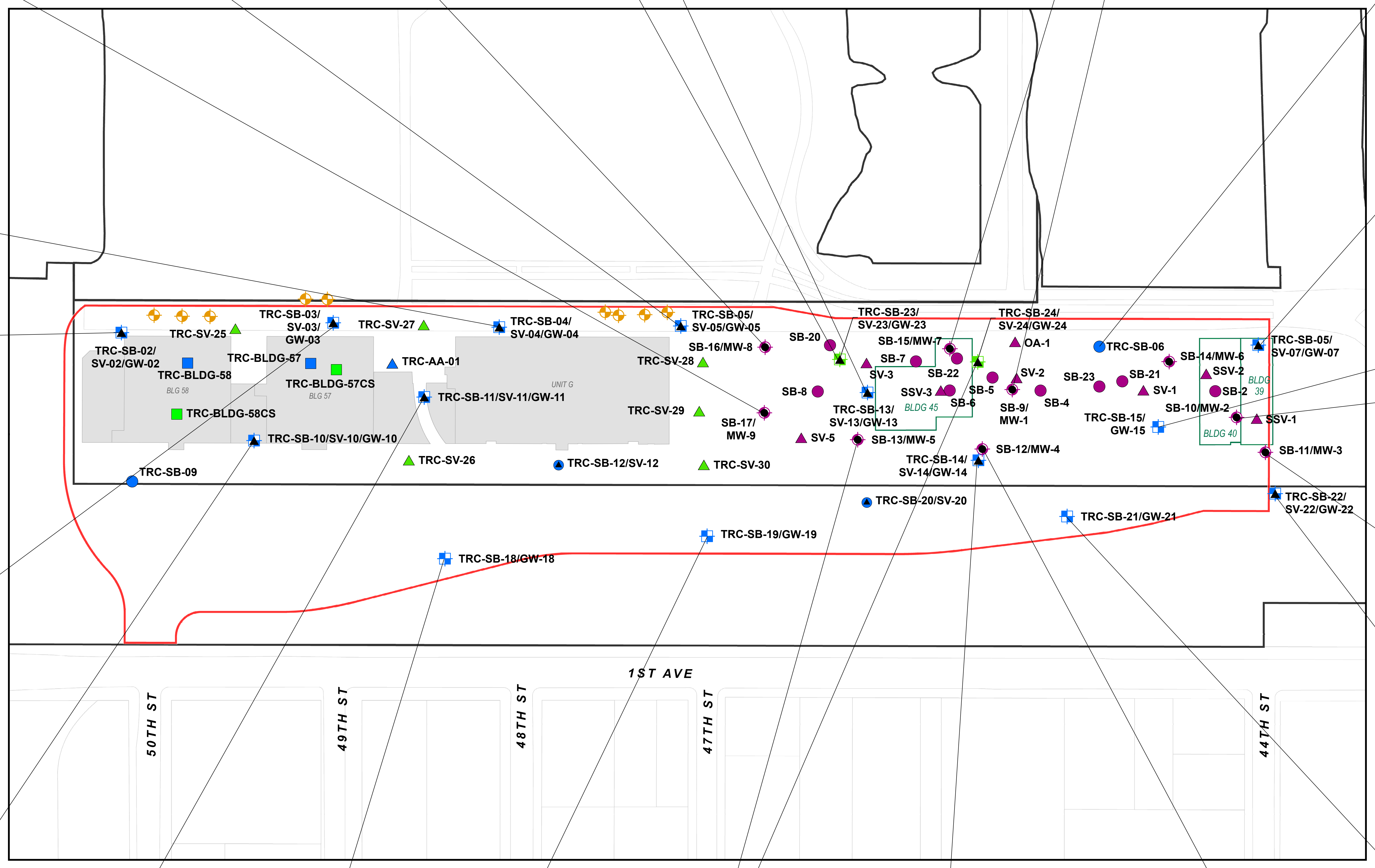
MW-1	10/14/2013	10/14/2013 DUP
SVOCs		
Benzo(a)anthrancene	**0.03**	ND
Chrysene	**0.02**	ND
Metals, Filtered		
Iron	**2170**	**2400**
Magnesium	**35600**	NE
Manganese	**706**	**692**
Sodium	**279000**	**260000**

MW-6	10/15/2013
SVOCs	
Benzo(a)anthrancene	**0.04**
Benzo(b)fluoranthene	**0.03**
Chrysene	**0.03**
Metals, Filtered	
Antimony	**45**
Iron	**590**
Sodium	**104000**

TRC-GW-04	3/5/2020
Metals, Total	
Antimony	**10**
Iron	**19000**
Manganese	**1300**
Sodium	**50000**
Metals, Filtered	
Antimony	**17**
Sodium	**76000**

TRC-GW-02	3/5/2020
VOCs	
Tetrachloroethene	**9.3**
Metals, Total	
Antimony	**15**
Iron	**800**
Sodium	**150000**
Metals, Filtered	
Antimony	**15**
Sodium	**160000**

TRC-GW-03	3/5/2020
VOCs	
Trichloroethene	**8.3**
Metals, Total	
Iron	**9300**
Manganese	**480**
Sodium	**150000**
Metals, Filtered	
Sodium	**180000**



TRC-GW-07	3/6/2020
Metals, Total	
Chromium (Total)	**150**
Iron	**88000**
Lead	**39**
Manganese	**2500**
Nickel	**200**
Selenium	**15**
Sodium	**270000**
Metals, Filtered	
Sodium	**290000**

TRC-GW-15	3/9/2020
Metals, Total	
Antimony	**46**
Iron	**7000**
Manganese	**530**
Sodium	**52000**
Metals, Filtered	
Antimony	**46**
Sodium	**54000**

MW-2	10/14/2013
SVOCs	
Benzo(a)anthrancene	**0.03**
Metals, Filtered	
Antimony	**9**
Manganese	**7700**
Sodium	**131000**

MW-3	10/14/2013
Metals, Filtered	
Iron	**460**
Manganese	**7470**
Sodium	**91500**

TRC-GW-22	3/9/2020
SVOCs	
Naphthalene	**11**
Metals, Total	
Iron	**63000**
Manganese	**3100**
Sodium	**47000**
Metals, Filtered	
Iron	**54000**
Manganese	**3100**
Sodium	**47000**

TRC-GW-10	3/4/2020
VOCs	
1,1-Dichloroethane	**16**
1,1-Dichloroethene	**35**
cis-1,2-Dichloroethene	**16**
Tetrachloroethene	**35**
Trichloroethene	**85**
Metals, Total	
Iron	**1500**
Manganese	**10000**
Sodium	**170000**
Metals, Filtered	
Manganese	**10000**
Sodium	**170000**

TRC-GW-11	3/6/2020
Metals, Total	
Antimony	**7.4**
Iron	**1100**
Lead	**44**
Sodium	**100000**
Metals, Filtered	
Antimony	**7.4**
Sodium	**100000**

TRC-GW-18	3/4/2020
Metals, Total	
Iron	**2100**

TRC-GW-19	3/4/2020
Metals, Total	
Iron	**1300**
Manganese	**340**
Sodium	**110000**
Metals, Filtered	
Sodium	**100000**

MW-5	10/14/2013
Metals, Filtered	
Sodium	**250000**

TRC-GW-24	3/10/2020
Polychlorinated Biphenyl (PCBs)	
Total PCBs	**0.81**
Metals, Total	
Antimony	**4.1**
Arsenic	**33**
Chromium (Total)	**67**
Copper	**250**
Iron	**54000**
Lead	**450**
Manganese	**1600**
Sodium	**41000**
Metals, Filtered	
Iron	**4400**
Manganese	**840**
Sodium	**39000**

TRC-GW-14	3/6/2020	3/6/2020 DUP
Metals, Total		
Arsenic	NE	**73**
Chromium (Total)	ND	**230**
Copper	ND	**360**
Iron	**23000**	**190000**
Lead	**63**	**320**
Magnesium	NE	**63000**
Manganese	**2400**	**4700**
Nickel	ND	**350**
Selenium	ND	**16**
Sodium	**170000**	**150000**
Metals, Filtered		
Iron	**12000**	**990**
Manganese	**2300**	**2200**
Sodium	**180000**	**95000**

MW-4	10/14/2013
SVOCs	
Benzo(a)anthrancene	**0.11**
Benzo(a)pyrene	**0.05**
Benzo(b)fluoranthene	**0.08**
Benzo(k)fluoranthene	**0.03**
Chrysene	**0.09**
Indeno(1,2,3-cd)pyrene	**0.03**
Metals, Filtered	
Iron	**3220**
Manganese	**1950**
Sodium	**156000**

TRC-GW-21	3/9/2020
Metals, Total	
Iron	**8200**
Manganese	**620**
Sodium	**40000**
Metals, Filtered	
Sodium	**42000**

LEGEND

⊕	LOCATION OF EXISTING MONITORING WELL
⊕	LOCATION OF MONITORING WELL, TRC PHASE II 2020
●	LOCATION OF SOIL BORING, TRC PHASE II 2020
⊞	LOCATION OF SOIL BORING AND TEMPORARY MONITORING WELL, TRC PHASE II 2020
▲	LOCATION OF SOIL BORING, SOIL VAPOR POINT, AND TEMPORARY MONITORING WELL, TRC PHASE II 2020
▲	LOCATION OF SOIL BORING AND SOIL VAPOR POINT, TRC PHASE II 2020
▲	LOCATION OF AMBIENT AIR SAMPLE, TRC PHASE II 2020
■	LOCATION OF INDOOR AIR SAMPLE, TRC PHASE II 2020
●	LOCATION OF SOIL BORING, GCE RI 2013
⊕	LOCATION OF SOIL BORING AND MONITORING WELL, GCE RI 2013
▲	LOCATION OF VAPOR INTRUSION SAMPLE, GCE RI 2013

SV - SOIL VAPOR SAMPLING LOCATION
SSV - SUB-SLAB SOIL VAPOR SAMPLING LOCATION
OA - OUTDOOR AIR SAMPLING LOCATION

▲	LOCATION OF SOIL BORING, SOIL VAPOR POINT, AND TEMPORARY MONITORING WELL, TRC SUPPLEMENTAL PHASE II ESA, 2020
▲	LOCATION OF AMBIENT AIR SAMPLE, TRC SUPPLEMENTAL PHASE II ESA, 2020
🟩	LOCATION OF INDOOR AIR SAMPLE, TRC SUPPLEMENTAL PHASE II ESA, 2020
🟥	BCP SITE BOUNDARY
▭	APPROXIMATE LOCATION OF FORMER BUILDINGS DEMOLISHED IN 2015
▨	LOCATION OF EXISTING BUILDING
▭	LOT BOUNDARY

Parameter	NYSDEC AWQSGV
VOCs	
1,1-Dichloroethane	5
1,1-Dichloroethene	5
cis-1,2-Dichloroethene	5
Tetrachloroethene	5
Trichloroethene	5
SVOCs	
Benzo(a)anthrancene	0.002
Benzo(a)pyrene	0
Benzo(b)fluoranthene	0.002
Benzo(k)fluoranthene	0.002
Chrysene	0.002
Indeno(1,2,3-cd)pyrene	0.002
Naphthalene	10
Polychlorinated Biphenyl (PCBs)	
Total PCBs	0.09
Metals, Total	
Arsenic	25
Antimony	3
Chromium (Total)	50
Copper	200
Iron	300
Lead	25
Magnesium	35000
Manganese	300
Nickel	100
Selenium	10
Sodium	20000
Metals, Filtered	
Antimony	3
Iron	300
Lead	25
Magnesium	35000
Manganese	300
Sodium	20000
Pesticides	
Dieldrin	0.004

NOTES

1. ALL CONCENTRATIONS SHOWN IN MICROGRAMS PER LITER
2. BOLD DATA INDICATES THAT PARAMETER WAS DETECTED ABOVE THE NYSDEC AWQSGVS

AWQSGVS - AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES
DUP - DUPLICATE SAMPLE
ND - NOT DETECTED
NE - NO EXCEEDANCE
NYSDEC - NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SVOCS - SEMIVOLATILE ORGANIC COMPOUNDS
VOCS - VOLATILE ORGANIC COMPOUNDS

100 0 100'

Title:

SUMMARY OF EXCEEDANCES IN GROUNDWATER

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL LLC

ROUX

Compiled by: P.K.	Date: 05/14/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	7
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y100.7.mxd		

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TRC-SV-25	3/10/2020
VOCs	
1,1,1-Trichloroethane	39.1
1,1-Dichloroethane	10.4
1,1-Dichloroethene	61.9
1,2,4-Trimethylbenzene	10.9
1,3,5-Trimethylbenzene	3.02
2-Butanone	99.7
2-Hexanone	34.1
4-Ethyltoluene	3.28
Acetone	1380
Benzene	2.03
Chloroform	9.67
cis-1,2-Dichloroethene	23.1
Cyclohexane	1.87
Dichlorodifluoromethane	3270
Ethanol	81.6
Ethyl Acetate	4.61
Ethylbenzene	6.52
Heptane	6.68
Isopropanol	30.7
n-Hexane	3.21
o-Xylene	6.34
m,p-Xylene	15.2
Tertiary Butyl Alcohol	22.3
Tetrachloroethene	165
Toluene	8.25
Trichloroethene	548

TRC-SV-03	3/5/2020
VOCs	
1,1,1-Trichloroethane	36.9
1,1-Dichloroethane	3.64
1,1-Dichloroethene	3.31
1,2,4-Trimethylbenzene	3.79
1,3,5-Trimethylbenzene	1.08
1,3-Butadiene	3.01
2,2,4-Trimethylpentane	6.07
2-Butanone	36.3
2-Hexanone	13.1
Acetone	518
Benzene	4.22
Carbon Disulfide	1.19
Chloroform	3.28
Chloromethane	0.673
cis-1,2-Dichloroethene	1.44
Cyclohexane	6.13
Dichlorodifluoromethane	2.1
Ethanol	14.4
Ethylbenzene	4.52
Heptane	5.9
Isopropanol	2.93
n-Hexane	6.31
o-Xylene	3.42
m,p-Xylene	8.21
Tertiary Butyl Alcohol	4.7
Tetrachloroethene	57.2
Toluene	12.7
Trichloroethene	29.6

TRC-SV-27	3/10/2020
VOCs	
1,1,1-Trichloroethane	15.7
1,1-Dichloroethane	18.3
1,1-Dichloroethene	31.6
1,2,4-Trimethylbenzene	9.93
1,3,5-Trimethylbenzene	2.6
2-Butanone	56.6
2-Hexanone	21.4
4-Ethyltoluene	2.11
Acetone	744
Chloroform	5.71
cis-1,2-Dichloroethene	5.23
Dichlorodifluoromethane	3.13
Ethanol	14.1
Ethylbenzene	5.3
Heptane	3.82
Isopropanol	7.37
n-Hexane	1.22
o-Xylene	5.17
m,p-Xylene	12.6
Tertiary Butyl Alcohol	4.06
Tetrachloroethene	93
Toluene	6.67
Trichloroethene	64.5
Vinyl Chloride	0.792

TRC-SV-04	3/5/2020
VOCs	
1,2,4-Trimethylbenzene	6.64
1,3-Butadiene	4.2
2-Butanone	154
2-Hexanone	35.6
Acetone	1570
Benzene	4.89
Carbon Disulfide	3.15
Cyclohexane	4.27
Ethylbenzene	7.3
Heptane	10.6
Isopropanol	8.55
n-Hexane	7.15
o-Xylene	5.91
m,p-Xylene	13.7
Tertiary Butyl Alcohol	12.2
Tetrachloroethene	132
Toluene	13.2

TRC-SV-29	3/11/2020
VOCs	
1,2,4-Trimethylbenzene	7.52
2-Butanone	107
2-Hexanone	51.6
Acetone	931
Benzene	2.03
Ethanol	22.4
Ethylbenzene	6.56
Heptane	9.02
Isopropanol	23.5
n-Hexane	3.8
o-Xylene	6.12
m,p-Xylene	14.2
Tertiary Butyl Alcohol	6.82
Tetrachloroethene	841
Toluene	8.55
Trichloroethene	14.1

TRC-SV-05	3/5/2020
VOCs	
1,1,1-Trichloroethane	1.14
1,2,4-Trimethylbenzene	4.97
1,3,5-Trimethylbenzene	1.47
1,3-Butadiene	0.821
2-Butanone	14.5
2-Hexanone	3.96
4-Ethyltoluene	0.983
Acetone	249
Benzene	0.677
Chloroform	1.47
Dichlorodifluoromethane	2.08
Ethylbenzene	3.31
Heptane	1.61
n-Hexane	1.24
o-Xylene	3.25
m,p-Xylene	7.56
Tetrachloroethene	384
Toluene	3.69
Trichloroethene	2.1

SV-5	10/15/2013
VOCs	
1,2,4-Trimethylbenzene	22.1
1,3,5-Trimethylbenzene	6.14
4-Ethyltoluene	3.73
4-Isopropyltoluene	2.03
4-Methyl-2-pentanone (MIBK)	1.39
Acetone	498
Benzene	1.31
Carbon Tetrachloride	0.251
Dichlorodifluoromethane	2.12
Ethanol	34.1
Ethylbenzene	3.3
Heptane	2.58
Hexane	3.49
Isopropylalcohol	3.98
Isopropylbenzene	1.13
m,p-Xylene	11.7
Methyl Ethyl Ketone	33.6
Methylene Chloride	13.3
n-Butylbenzene	6.03
o-Xylene	5.9
Propylene	8.26
sec-Butylbenzene	2.14
Tetrachloroethene	138
Tetrahydrofuran	3.21
Toluene	9.9
Trichlorofluoromethane	1.4

TRC-SV-23	3/10/2020
VOCs	
1,2,4-Trimethylbenzene	10.9
1,3,5-Trimethylbenzene	3.21
1,3-Butadiene	1.5
2-Butanone	95.3
2-Hexanone	37.7
4-Ethyltoluene	2.75
Acetone	1230
Benzene	1.42
Carbon Disulfide	1.97
Cyclohexane	4.23
Dichlorodifluoromethane	2.61
Ethylbenzene	7.86
Heptane	8.28
Isopropanol	8.23
n-Hexane	2.67
o-Xylene	7.43
m,p-Xylene	17.5
Tertiary Butyl Alcohol	8.09
Tetrachloroethene	447
Tetrahydrofuran	7.52
Toluene	9.61

SV-3	10/15/2013
VOCs	
1,2,4-Trimethylbenzene	26.7
1,3,5-Trimethylbenzene	7.07
2-Hexanone (MBK)	4.71
4-Ethyltoluene	5.11
4-Isopropyltoluene	2.47
4-Methyl-2-pentanone (MIBK)	1.1
Acetone	420
Benzene	1.37
Carbon Disulfide	2.36
Chloroform	2.88
Cyclohexane	2.86
Dichlorodifluoromethane	2.27
Ethanol	12.3
Ethylbenzene	3.12
Heptane	2.01
Hexane	6.16
Isopropylalcohol	3.29
Isopropylbenzene	1.13
m,p-Xylene	12.3
Methyl Ethyl Ketone	15.6
Methylene Chloride	8.02
n-Butylbenzene	7.35
o-Xylene	6.38
Propylene	7.81
sec-Butylbenzene	1.48
Tetrachloroethene	350
Tetrahydrofuran	10.2
Toluene	10.2
Trichloroethene	0.537
Trichlorofluoromethane	1.57

SSV-3	10/15/2013
VOCs	
1,2,4-Trimethylbenzene	311
1,3,5-Trimethylbenzene	105
2-Hexanone (MBK)	11.8
4-Ethyltoluene	31.2
4-Isopropyltoluene	17.7
4-Methyl-2-pentanone (MIBK)	4.95
Acetone	214
Benzene	1.72
Bromoform	1.24
Carbon Disulfide	1.4
Carbon Tetrachloride	0.503
Chloroform	1.22
Chloromethane	1.03
Dichlorodifluoromethane	2.32
Ethanol	527
Ethylbenzene	18.3
Heptane	5.36
Hexane	3.52
Isopropylalcohol	21.4
Isopropylbenzene	15
m,p-Xylene	72
Methyl Ethyl Ketone	86.6
Methylene Chloride	17.5
n-Butylbenzene	117
o-Xylene	48.2
Propylene	3.65
sec-Butylbenzene	12
Styrene	2
Tetrachloroethene	2.37
Tetrahydrofuran	38.3
Toluene	14.3
Trichloroethene	0.322
Trichlorofluoromethane	1.29

TRC-SV-24	3/10/2020
VOCs	
1,2,4-Trimethylbenzene	12.1
2-Butanone	248
2-Hexanone	85.7
Acetone	2920
Cyclohexane	5.99
Ethanol	68
Ethylbenzene	10.3
Heptane	17.4
Isopropanol	57.5
n-Hexane	7.79
o-Xylene	9.12
m,p-Xylene	21.3
Tertiary Butyl Alcohol	17.2
Tetrachloroethene	124
Toluene	14.6

OA-1	10/15/2013
VOCs	
Acetone	15.5
Benzene	1.5
Carbon Tetrachloride	0.503
Dichlorodifluoromethane	2.22
Ethanol	21.6
Heptane	4.3
Hexane	2.82
Isopropylalcohol	4.99
m,p-Xylene	2.13
Methyl Ethyl Ketone	2.59
Methylene Chloride	9.34
Propylene	2.37
Tetrachloroethene	4.88
Toluene	5.01
Trichlorofluoromethane	1.18

SV-1	10/15/2013
VOCs	
1,2,4-Trimethylbenzene	32.4
1,3,5-Trimethylbenzene	8.84
2-Hexanone (MBK)	4.75
4-Ethyltoluene	4.22
4-Isopropyltoluene	2.69
4-Methyl-2-pentanone (MIBK)	6.71
Acetone	406
Benzene	1.47
Carbon Disulfide	2.12
Carbon Tetrachloride	0.629
Chloromethane	1.22
Dichlorodifluoromethane	2.32
Ethanol	98.7
Ethyl Acetate	1.55
Ethylbenzene	3.82
Heptane	1.92
Hexane	2.46
Isopropylalcohol	6.63
Isopropylbenzene	1.23
m,p-Xylene	13.9
Methyl Ethyl Ketone	37.1
Methylene Chloride	9.44
n-Butylbenzene	9.71
o-Xylene	7.07
Propylene	5.44
sec-Butylbenzene	2.47
Tetrachloroethene	1.56
Tetrahydrofuran	15.6
Toluene	11.7
Trichloroethene	10.5
Trichlorofluoromethane	1.18

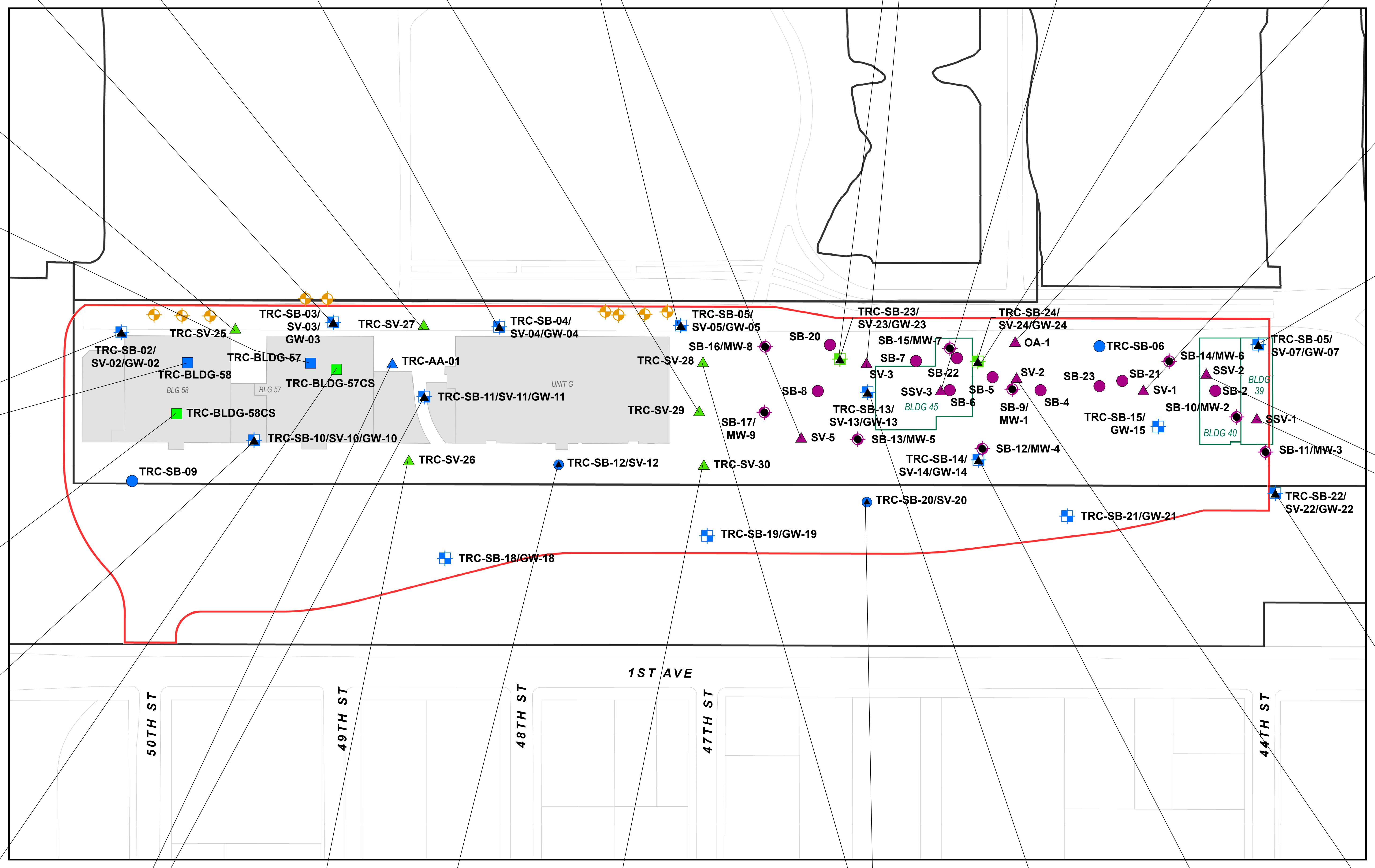
TRC-BLDG-57	3/6/2020
VOCs	
Acetone	6.27
Benzene	0.869
Carbon Tetrachloride	0.428
Chloromethane	1.04
Dichlorodifluoromethane	2.13
Ethanol	72
Ethyl Acetate	2.95
Isopropanol	3.74
Tetrachloroethene	0.264
Toluene	1.81
Trichlorofluoromethane	1.26

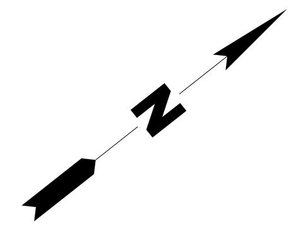
TRC-SV-02	3/5/2020
VOCs	
1,1,1-Trichloroethane	2.43
1,2,4-Trimethylbenzene	3.57
1,3,5-Trimethylbenzene	1.05
2,2,4-Trimethylpentane	5.93
2-Butanone	17.2
2-Hexanone	4.51
Acetone	530
Benzene	1.48
Carbon Disulfide	2.71
Chloromethane	0.442
Cyclohexane	2.57
Dichlorodifluoromethane	2.16
Ethanol	14.8
Ethylbenzene	4.78
Heptane	3.27
Isopropanol	3.59
n-Hexane	1.99
o-Xylene	4.14
m,p-Xylene	10.1
Tertiary Butyl Alcohol	3.73
Tetrachloroethene	59.3
Tetrahydrofuran	3.63
Toluene	12.2
Trichlorofluoromethane	1.15

TRC-BLDG-58	3/6/2020
VOCs	
Acetone	6.51
Benzene	0.728
Carbon Disulfide	1.2
Carbon Tetrachloride	0.415
Chloromethane	1.02
Dichlorodifluoromethane	2.11
Ethanol	124
Ethyl Acetate	1.85
Isopropanol	36.9
Methylene Chloride	1.87
n-Hexane	0.818
Styrene	1.87
Tetrachloroethene	0.678
Tetrahydrofuran	1.66
Toluene	3.6
Trichloroethene	0.269

TRC-BLDG-58CS	3/11/2020
VOCs	
Acetone	29
Carbon Tetrachloride	0.409
Chloromethane	1.17
Cyclohexane	1.67
Dichlorodifluoromethane	2.29
Ethanol	17.4
Isopropanol	10.1
Methylene Chloride	1.79
n-Hexane	1.18
Tetrachloroethene	0.271
Toluene	5.2
Trichloroethene	0.124
Trichlorofluoromethane	1.22

TRC-SV-10	3/4/2020
VOCs	
1,1,1-Trichloroethane	43.3
1,1,2,2-Tetrachloroethane	0.475
1,1-Dichloroethene	10.4
1,2,4-Trimethylbenzene	0.776
1,2-Dibromoethane	19
1,2-Dichloroethane	720
1,3,5-Trimethylbenzene	3.02
1,3-Butadiene	153
2,2,4-Trimethylpentane	1.02
3-Chloropropene	117
4-Methyl-2-pentanone (MIBK)	42.5
Acetone	44.8
Benzyl Chloride	6.74
Bromodichloromethane	3.13
Bromomethane	5.36
Carbon Disulfide	43.3
Carbon Tetrachloride	3.51
Chloroethane	1.42
cis-1,3-Dichloropropene	177
Dibromochloromethane	5.66
Freon-113	11.4
Freon-114	12.7
Isopopanol	153
n-Hexane	17.9
Tertiary Butyl Alcohol	7.73
Tetrachloroethene	1.92
Tetrahydrofuran	2.86
Toluene	9.68
Trichloroethene	177





TRC-BLDG-57CS	3/11/2020
VOCs	
1,2-Dichloroethane	1
Carbon Tetrachloride	0.44
Chloromethane	0.712
Dichlorodifluoromethane	2.38
Methylene Chloride	11.8
Tetrachloroethene	2.63
Trichloroethene	0.87
Trichlorofluoromethane	1.6

TRC-AA-01	3/6/2020
VOCs	
Acetone	4.92
Benzene	0.706
Carbon Tetrachloride	0.384
Chloromethane	1.08
Dichlorodifluoromethane	2.14
Ethanol	13.5
Tetrachloroethene	0.298
Toluene	1.66
Trichlorofluoromethane	1.21

TRC-SV-11	3/5/2020
VOCs	
1,2,4-Trimethylbenzene	6.44
2,2,4-Trimethylpentane	12.2
2-Butanone	62.2
2-Hexanone	16.1
Acetone	850
Benzene	3.77
Carbon Disulfide	3.21
Chloromethane	0.999
Cyclohexane	10.8
Dichlorodifluoromethane	2.29
Ethylbenzene	6.65
Heptane	11.1
n-Hexane	17.6
o-Xylene	5.34
m,p-Xylene	12.7
Tertiary Butyl Alcohol	5.06
Tetrachloroethene	92.2
Toluene	12.1

TRC-SV-26	3/11/2020
VOCs	
1,1,1-Trichloroethane	7.58
1,2,4-Trimethylbenzene	8.6
2-Butanone	188
2-Hexanone	50.8
Acetone	1810
Benzene	6.64
Carbon Disulfide	5.67
Carbon Tetrachloride	41.6
Chloroform	6.98
Cyclohexane	4.51
Dichlorodifluoromethane	3.3
Ethanol	77.6
Ethylbenzene	9.21
Heptane	15.4
Isopropanol	41.5
n-Hexane	12.6
o-Xylene	10
m,p-Xylene	25.8
Tertiary Butyl Alcohol	13.4
Tetrachloroethene	327
Toluene	17.4
Trichloroethene	5.7

TRC-SV-12	3/4/2020
VOCs	
1,1,2,2-Tetrachloroethane	0.661
1,1-Dichloroethene	11.2
1,2-Dibromoethane	15.7
1,2-Dichloroethane	380
1,3,5-Trimethylbenzene	1.79
2,2,4-Trimethylpentane	2.6
4-Methyl-2-pentanone (MIBK)	30.1
Bromomethane	9.23
Carbon Tetrachloride	3.71
Chloroethane	3.68
Dibromochloromethane	8.07
Freon-113	8.1
Freon-114	16.1
Isopropanol	63.1
n-Hexane	16.9
Tertiary Butyl Alcohol	6.82
Tetrachloroethene	1.4
Tetrahydrofuran	2.06
Toluene	7.13

TRC-SV-30	3/10/2020
VOCs	
1,2,4-Trimethylbenzene	10.8
1,3-Butadiene	4.98
2-Butanone	196
2-Hexanone	43.4
Acetone	2420
Ethanol	76.9
Ethylbenzene	8.86
Heptane	12
Isopropanol	41.3
n-Hexane	6.27
o-Xylene	7.99
m,p-Xylene	19.4
Tertiary Butyl Alcohol	12.9
Tetrachloroethene	435
Toluene	11.3
Trichloroethene	7.31

TRC-SV-28	3/11/2020
VOCs	
1,2,4-Trimethylbenzene	6.49
2-Butanone	152
2-Hexanone	47.5
Acetone	1590
Ethanol	34.1
Ethylbenzene	5.73
Heptane	8.44
Isopropanol	33.9
n-Hexane	3.81
o-Xylene	5.56
m,p-Xylene	13
Tertiary Butyl Alcohol	9.7
Tetrachloroethene	1480
Toluene	7.5
Trichloroethene	20.6

TRC-SV-20	3/9/2020
VOCs	
1,2,4-Trimethylbenzene	17.2
1,3-Butadiene	30.3
2,2,4-Trimethylpentane	10.9
2-Butanone	277
2-Hexanone	83.2
Acetone	3780
Benzene	5.27
Carbon Disulfide	8.72
Chloromethane	2.77
Cyclohexane	13
Ethanol	92.1
Ethylbenzene	11.4
Heptane	22.7
Isopropanol	52.4
n-Hexane	34.6
o-Xylene	10.3
m,p-Xylene	26.6
Tertiary Butyl Alcohol	22.5
Tetrachloroethene	148
Toluene	18.3

TRC-SV-13	3/5/2020
VOCs	
1,2,4-Trimethylbenzene	5.85
2-Butanone	110
2-Hexanone	27.7
Acetone	1240
Benzene	1.5
Carbon Disulfide	5.57
Cyclohexane	2.6
Dichlorodifluoromethane	2.11
Ethanol	40.1
Ethylbenzene	5.95
Heptane	6.88
Isopropanol	8.85
Methylene Chloride	7.96
n-Hexane	3.7
o-Xylene	5
m,p-Xylene	11.8
Tertiary Butyl Alcohol	10.6
Tetrachloroethene	104
Toluene	9.08

TRC-SV-14	3/6/2020
VOCs	
1,2,4-Trimethylbenzene	7.47
2-Butanone	136
2-Hexanone	36.8
Acetone	1580
Carbon Disulfide	1.92
Ethylbenzene	7.12
Heptane	7.87
Isopropanol	9.37
n-Hexane	5.08
o-Xylene	6.43
m,p-Xylene	15
Tertiary Butyl Alcohol	10.9
Tetrachloroethene	90.2
Toluene	10.5

SV-2	10/21/2013
VOCs	
1,2,4-Trimethylbenzene	29.9
1,3,5-Trimethylbenzene	20
4-Ethyltoluene	18.2
4-Isopropyltoluene	2.41
Acetone	256
Benzene	37.7
Carbon Disulfide	1.12
Carbon Tetrachloride	0.754
Chloroform	1.02
Cyclohexane	664
Ethanol	129
Ethylbenzene	127
Heptane	491
Hexane	553
Isopropylbenzene	31.4
m,p-Xylene	159
n-Butylbenzene	4.88
o-Xylene	139
sec-Butylbenzene	14.6
Tetrachloroethene	75.2
Toluene	190
Trichloroethene	607
Trichlorofluoromethane	1.74

TRC-SV-22	3/9/2020
VOCs	
1,1-Dichloroethane	10.9
1,2,4-Trimethylbenzene	10.2
2-Butanone	295
Acetone	4300
Benzene	54.6
Cyclohexane	238
Ethanol	80.5
Ethylbenzene	97.3
Heptane	309
Methane	0.178
n-Hexane	94.5
o-Xylene	22.8
m,p-Xylene	69.5
Tetrachloroethene	104
Toluene	32.6
Vinyl Chloride	12.5

TRC-SV-07	3/6/2020
VOCs	
1,2,4-Trimethylbenzene	6.64
1,3-Butadiene	1.88
2-Butanone	165
2-Hexanone	40
Acetone	1900
Benzene	2.8
Ethanol	51.1
Ethylbenzene	7.12
Heptane	8.73
Isopropanol	13.8
n-Hexane	4.3
o-Xylene	5.82
m,p-Xylene	14.3
Tertiary Butyl Alcohol	14.8
Tetrachloroethene	86.1
Toluene	11.9

SSV-2	10/15/2013
VOCs	
1,2,4-Trimethylbenzene	94.3
1,3,5-Trimethylbenzene	51.6
4-Ethyltoluene	19.7
4-Isopropyltoluene	5.38
4-Methyl-2-pentanone (MIBK)	3.23
Acetone	377
Benzene	4.09
Carbon Disulfide	1.21
Carbon Tetrachloride	0.503
Cyclohexane	4.58
Dichlorodifluoromethane	2.08
Ethanol	35
Ethylbenzene	26.4
Heptane	7.99
Hexane	9.93
Isopropylalcohol	21.3
Isopropylbenzene	14.7
m,p-Xylene	98.9
Methyl Ethyl Ketone	42.4
Methylene Chloride	11.6
n-Butylbenzene	12.4
o-Xylene	57.3
Propylene	5.54
sec-Butylbenzene	13.7
Tetrachloroethene	37.5
Tetrahydrofuran	40.1
Toluene	29.2
Trichloroethene	0.644
Trichlorofluoromethane	1.18

SSV-1	10/15/2013
VOCs	
1,2,4-Trimethylbenzene	23.9
4-Ethyltoluene	3.88
4-Isopropyltoluene	2.41
4-Methyl-2-pentanone (MIBK)	1.35
Acetone	223
Benzene	5.65
Carbon Disulfide	5.13
Carbon Tetrachloride	1.19
Chloromethane	1.16
Cyclohexane	10.4
Dichlorodifluoromethane	2.32
Ethanol	142
Ethyl Acetate	28
Ethylbenzene	22.2
Heptane	16.2
Hexane	74.7
Isopropylalcohol	7.22
Isopropylbenzene	2.01
m,p-Xylene	79
Methyl Ethyl Ketone	62.8
Methylene Chloride	62.8
n-Butylbenzene	7.02
o-Xylene	40.2
Propylene	9.58
Sec-butylbenzene	1.81
Tetrachloroethene	3.12
Tetrahydrofuran	78.1
Toluene	91.9
Trichloroethene	1.4
Trichlorofluoromethane	1.29

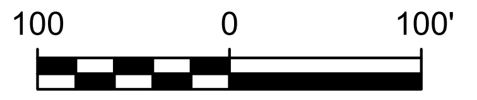
LEGEND

⊕	LOCATION OF EXISTING MONITORING WELL
⊕	LOCATION OF MONITORING WELL, TRC PHASE II 2020
●	LOCATION OF SOIL BORING, TRC PHASE II 2020
■	LOCATION OF SOIL BORING AND TEMPORARY MONITORING WELL, TRC PHASE II 2020
▲	LOCATION OF SOIL BORING, SOIL VAPOR POINT, AND TEMPORARY MONITORING WELL, TRC PHASE II 2020
▲	LOCATION OF SOIL BORING AND SOIL VAPOR POINT, TRC PHASE II 2020
▲	LOCATION OF AMBIENT AIR SAMPLE, TRC PHASE II 2020
■	LOCATION OF INDOOR AIR SAMPLE, TRC PHASE II 2020
●	LOCATION OF SOIL BORING, GCE RI 2013
⊕	LOCATION OF SOIL BORING AND MONITORING WELL, GCE RI 2013
▲	LOCATION OF VAPOR INTRUSION SAMPLE, GCE RI 2013
	SV - SOIL VAPOR SAMPLING LOCATION SSV - SUB-SLAB SOIL VAPOR SAMPLING LOCATION OA - OUTDOOR AIR SAMPLING LOCATION
▲	LOCATION OF SOIL BORING, SOIL VAPOR POINT, AND TEMPORARY MONITORING WELL, TRC SUPPLEMENTAL PHASE II ESA, 2020
▲	LOCATION OF AMBIENT AIR SAMPLE, TRC SUPPLEMENTAL PHASE II ESA, 2020
■	LOCATION OF INDOOR AIR SAMPLE, TRC SUPPLEMENTAL PHASE II ESA, 2020
🟥	BCP SITE BOUNDARY
🟩	APPROXIMATE LOCATION OF FORMER BUILDINGS DEMOLISHED IN 2015
▨	LOCATION OF EXISTING BUILDING
☐	LOT BOUNDARY

NOTES

1. ALL CONCENTRATIONS SHOWN IN MICROGRAMS PER CUBIC METER (EXCEPT METHANE)
2. METHANE CONCENTRATION REPORTED AS VOLUME-VOLUME PERCENTAGE
3. BOLD DATA INDICATES THAT PARAMETER WAS DETECTED ABOVE THE LABORATORY REPORTING LIMITS

VOCS - VOLATILE ORGANIC COMPOUNDS



Title:

SUMMARY OF DETECTIONS IN SOIL VAPOR

5000 1ST AVENUE
BROOKLYN, NEW YORK

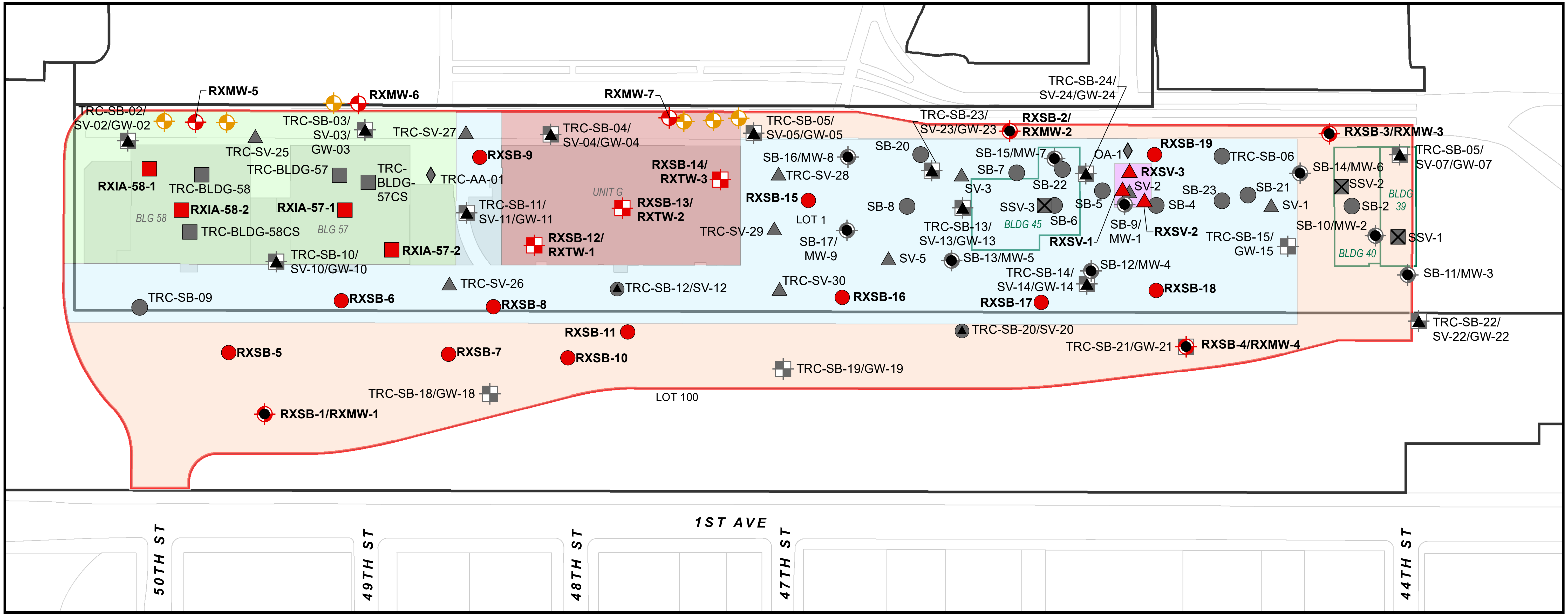
Prepared for:

STEINER SEQUEL LLC

ROUX

Compiled by: P.K.	Date: 05/14/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	8
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y100.8.mxd		

V:\GIS\PROJECTS\3454\0001Y\100\3454.0001Y100.8.MXD



LEGEND

● LOCATION OF PROPOSED RI SOIL BORING

⊕ LOCATION OF PROPOSED RI SOIL BORING/ PERMANENT MONITORING WELL

⊞ LOCATION OF PROPOSED RI SOIL BORING/TEMPORARY MONITORING WELL

■ LOCATION OF PROPOSED RI INDOOR AIR SAMPLE

▲ LOCATION OF PROPOSED RI SOIL VAPOR SAMPLE

⊕ LOCATION OF EXISTING MONITORING WELL TO BE SAMPLED DURING RI (SEE NOTE 2)

⊕ LOCATION OF EXISTING MONITORING WELL (SEE NOTE 1)

⊕ LOCATION OF PREVIOUSLY COMPLETED SOIL BORING AND MONITORING WELL

⊞ LOCATION OF PREVIOUSLY COMPLETED SOIL BORING, SOIL VAPOR POINT, AND TEMPORARY MONITORING WELL

⊞ LOCATION OF PREVIOUSLY COMPLETED SOIL BORING AND TEMPORARY MONITORING WELL

● LOCATION OF PREVIOUSLY COMPLETED SOIL BORING

● LOCATION OF PREVIOUSLY COMPLETED SOIL BORING AND SOIL VAPOR POINT

◆ LOCATION OF PREVIOUSLY COMPLETED AMBIENT AIR SAMPLE

■ LOCATION OF PREVIOUSLY COMPLETED INDOOR AIR SAMPLE

☒ LOCATION OF PREVIOUSLY COMPLETED SUB-SLAB SOIL VAPOR POINT

▲ LOCATION OF PREVIOUSLY COMPLETED SOIL VAPOR POINT

▭ BCP SITE BOUNDARY

▭ APPROXIMATE LOCATION OF FORMER BUILDINGS DEMOLISHED IN 2015

▬ LOCATION OF EXISTING BUILDING

▭ LOT BOUNDARY

▬ AREA OF CONCERN 1

▬ AREA OF CONCERN 2

▬ AREA OF CONCERN 3

▬ AREA OF CONCERN 4

▬ AREA OF CONCERN 5

NOTE

1. EXISTING MONITORING WELL LOCATIONS REPORTED IN TRC PHASE II, 2020.
2. MONITORING WELL CONDITIONS AND LOCATIONS WILL BE CONFIRMED DURING SITE RECONNAISSANCE PRIOR TO RIWP IMPLEMENTATION

N

125 0 125'

Title:

PROPOSED SAMPLE LOCATIONS

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL, LLC

ROUX

Compiled by: P.K.	Date: 08/24/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	9
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y105.9.mxd		

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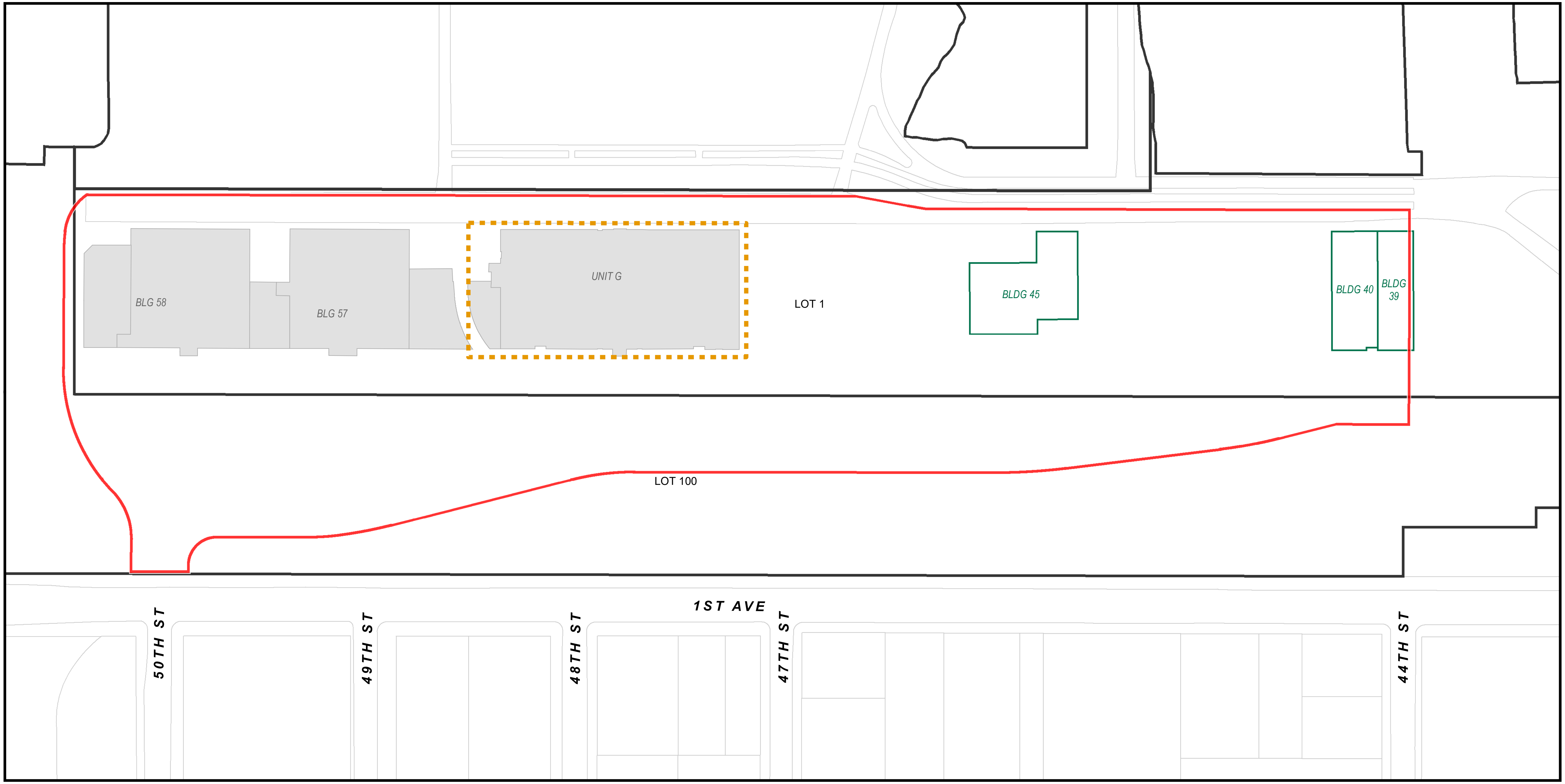


LEGEND

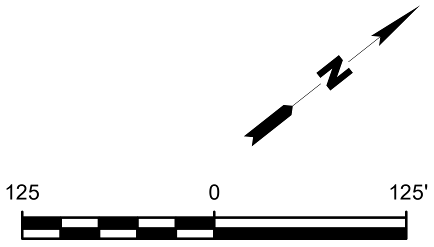
🟥 BCP SITE BOUNDARY

🟩 APPROXIMATE LOCATION OF FORMER BUILDINGS DEMOLISHED IN 2015

▨ LOCATION OF EXISTING BUILDING

☐ LOT BOUNDARY

⬚ LOCATION OF UNIT G DEMOLITION AS PART OF INTERIM REMEDIAL MEASURE



Title:

PROPOSED INTERIM REMEDIAL MEASURE ACTIVITY LOCATION

5000 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL, LLC

ROUX

Compiled by: P.K.	Date: 08/23/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	10
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y105.10.mxd		

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APPENDICES

A. Previously Completed Environmental Investigation Analytical Data Tables
B. Quality Assurance Project Plan/Field Sampling Plan
C. Community Air Monitoring Plan
D. Site Specific Health and Safety Plan (Provided on CD in Bound Copy)

APPENDIX A

Previously Completed Environmental Investigation Analytical Data Tables

TABLE 1 - SOIL ANALYTICAL DATA SUMMARY

G. C Environmental, Inc Job Address: Bush Terminal Units 39, 40 & 45 5102 First Avenue Brooklyn, New York 11232 Project Id : 13-246-00	Lab Sample Id Collection Date Client Id Matrix Units	*6 NYCRR* *Part 375* *Table 375-6.8 (b)* *Restricted Use Soil* *Cleanup Objectives* **Restricted Residential**	*6 NYCRR* *Part 375* *Table 375-6.8 (b)* *Restricted Use Soil* *Cleanup Objectives* **Commercial**	*6 NYCRR* *Part 375* *Table 375-6.8 (b)* *Restricted Use Soil* *Cleanup Objectives* **Industrial**	BF64022 10/11/2013 SB-2 (0-2) Soil Result	BF64023 10/11/2013 SB-2 (5-10) Soil Result	BF64594 10/14/2013 SB-4 (0-2) Solid Result	BF64595 10/14/2013 SB-4 (5-10) Solid Result	BF64028 10/14/2013 SB-5 (0-2) Soil Result	BF64029 10/14/2013 SB-5 (5-10) Soil Result	BF64598 10/14/2013 SB-6 (0-2) Solid Result	BF64599 10/14/2013 SB-6 (5-10) Solid Result	BF64600 10/14/2013 SB-6 (0-2) DUP Solid Result	BF64601 10/14/2013 SB-6 (5-10) DUP Solid Result	BF64020 10/11/2013 SB-7 (0-2) Soil Result	BF64021 10/11/2013 SB-7 (5-10) Soil Result	BF52600 10/9/2013 SB-8 0-2 FT Soil Result	BF52601 10/9/2013 SB-8 7-10 FT Soil Result	BF64030 10/14/2013 SB-9 (0-2) Soil Result	BF64031 10/14/2013 SB-9 (5-10) Soil Result	BF64026 10/11/2013 SB-10 (0-2) Soil Result	BF64027 10/11/2013 SB-10 (5-10) Soil Result	BF64024 10/11/2013 SB-11 (0-2) Soil Result	BF64025 10/11/2013 SB-11 (5-10) Soil Result	BF64032 10/14/2013 SB-12 (0-2) Soil Result	BF64033 10/14/2013 SB-12 (5-10) Soil Result	BF64016 10/11/2013 SB-13 (0-2) Soil Result	BF64017 10/11/2013 SB-13 (5-10) Soil Result	BF64620 10/15/2013 SB-14 (0-2) Solid Result	BF64621 10/15/2013 SB-14 (5-10) Solid Result
Metals, Total																														
Aluminum	mg/Kg	ns	ns	ns	3,810	3,480	13,000	3,640	7,210	6,650	3,660	1,720	6,160	2,220	3,760	4,990	5,040	4,760	3,590	7,290	4,430	4,230	6,640	3,510	23,600	9,870	5,960	2,630	3,520	2,560
Antimony	mg/Kg	ns	ns	ns	ND	ND	ND	ND	ND	0.7	ND	ND	ND	ND	ND	ND	12.3	3.6	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND
Arsenic	mg/Kg	16	16	16	ND	ND	3.5	3.6	4.9	3.6	2	0.8	2.8	1.6	2.6	3	3.2	4.4	6.7	3	1.2	0.8	7.9	1.4	9	3.2	2.7	5	1.3	1.2
Barium	mg/Kg	400	400	10,000	25.9	22	47.1	11.3	33.6	31.3	30.4	6.8	33.2	9.1	17.9	29.8	56.1	39.7	16.6	11.8	28.9	24.3	46.2	22.9	180	33.2	28.7	15.6	45.2	19
Beryllium	mg/Kg	72	72	2700	0.22	0.22	0.57	0.3	0.32	0.27	0.21	ND	0.32	ND	0.22	0.31	0.34	0.32	0.19	0.33	0.26	0.25	0.33	0.24	1.03	0.51	0.34	0.32	0.23	0.19
Cadmium	mg/Kg	4.3	4.3	60	ND	ND	0.35	0.16	0.46	0.34	0.18	ND	0.24	ND	ND	0.24	0.25	0.3	ND	0.19	0.17	0.16	0.26	ND	0.67	0.24	0.2	0.18	0.66	ND
Calcium	mg/Kg	ns	ns	ns	806	1,130	903	460	1,660	1,020	895	562	1,300	669	984	1,070	2,190	4,750	526	3,710	1,790	1,190	1,540	1,270	2,040	1,550	2,370	391	1,700	1990
Chromium	mg/Kg	ns	ns	ns	7.55	7.55	17.9	7.54	11	9.3	10.1	5.74	48.1	7.25	9.04	11.6	12	10.9	6.12	14.5	10.2	8.62	15.3	7.6	36.8	16.8	8.65	10.6	10.2	6.18
Cobalt	mg/Kg	ns	ns	ns	3.28	3.22	6.31	4.88	4.73	5.49	3.17	2.45	5.01	2.48	3.71	5.17	4.22	3.69	2.56	3.82	3.59	3.48	5.76	2.63	14.2	4.62	4.04	3.86	3.19	2.2
Copper	mg/kg	270	270	10,000	8.17	7.71	13.9	5.74	19.2	14.6	16.7	3.73	17.8	4.29	8.55	14	21	20.5	6.04	11.5	9.74	9.55	16.9	8.01	66.2	15	12.4	6.09	13.9	12
Iron	mg/Kg	ns	ns	ns	10,000	10,000	20,500	9,740	15,600	14,100	9,130	5,140	12,800	8,000	9,760	14,700	11,200	12,000	7,870	13,600	9,180	8,630	14,600	7,280	35,500	15,500	11,800	11,700	8,770	6180
Lead	mg/Kg	400	400	3900	1.5	2.3	34.5	3.7	74.8	21.3	54.1	2.3	109	2	20.4	28.8	49.2	75.9	3.3	5.8	3.9	3.2	6.9	4.2	83.7	14.1	32.8	3	20.9	8
Magnesium	mg/Kg	ns	ns	ns	1,190	1,550	2,830	1,280	1,880	1,660	1,980	1,580	2,330	1,660	3,410	2,300	2,210	2,330	1,470	1,930	1,890	1,850	2,370	1,450	5,770	3,160	2,230	770	2,220	2,070
Manganese	mg/Kg	2,000	2,000	10,000	204	184	304	124	197	220	149	39	214	97.6	147	187	216	166	88.5	73.5	254	269	309	194	327	136	202	245	280	167
Mercury	mg/Kg	0.81	0.81	5.7	ND	ND	ND	ND	ND	ND	0.19	ND	0.23	ND	ND	0.12	0.29	0.44	ND	ND	ND	ND	ND	ND	0.11	ND	0.19	ND	ND	ND
Nickel	mg/Kg	310	310	10,000	8.99	6.97	18.7	7.02	12.9	13	16	16	19.6	14	32.7	21.8	15.2	14.8	12.3	9.4	12.4	12.6	25.2	9.37	55.7	17.6	12.1	6.36	13.1	7.72
Potassium	mg/Kg	ns	ns	ns	606	667	982	581	871	813	659	308	1,130	395	786	1,130	1,100	924	441	924	1,040	1,220	1,540	834	3,880	1,720	759	607	780	628
Selenium	mg/Kg	180	180	6800	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	mg/Kg	180	180	6800	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	mg/Kg	ns	ns	ns	93	118	189	140	46	46	112	174	176	120	169	234	108	109	106	153	662	611	255	357	253	170	216	85	100	144
Thallium	mg/Kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	mg/Kg	ns	ns	ns	15.7	14.4	23.4	12	15.6	14.6	12.8	7.9	17.2	9.6	13.8	19.8	16.9	15.1	11.3	21.3	14.4	12.9	25.7	12	49.2	24	14.2	13.8	13.3	7.4
Zinc	mg/Kg	10,000	10,000	10,000	12.1	18.4	42.3	20	125	119	36.2	9.5	40	11.1	22.1	31.6	49.8	86	22.2	32.8	19.2	19.4	57.9	19.9	148	34.5	53.2	21.1	38.6	20.2
SVOA TICS																														
2-Pentanone, 4-hydroxy-4-methyl- (RT 3.370)	mg/kg	ns	ns	ns	1.7	2.7	ND	ND	ND	ND	ND	ND	ND	ND	1.5	1.5	2.7	ND	ND	ND	ND	ND	2.3	2.7	ND	ND	1.6	2.2	ND	ND
unknown (RT 3.280)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.3	2.7	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.045)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 1.370)	mg/kg	ns	ns	ns	1.7	1.7	ND	ND	ND	ND	ND	ND	ND	ND	1.5	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 14.730)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 17.700)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 19.720)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 20.000)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.000)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7	1.5
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.010)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	1.5	1.2	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.020)	mg/kg	ns	ns	ns	ND	ND	ND	4.1	2.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[j]fluoranthene (RT 21.190)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 17.260)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 3.170)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs By SW 8082																														
PCB-1268	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1260	mg/kg	ns	ns	ns	ND	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatiles By SW8260																														
Acetone	mg/kg	100	500	1000	ND	ND	0.012	0.019	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0072	0.016	ND	ND	ND	ND
Carbon Disulfide	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl ethyl ketone	mg/kg	100	500	1000	ND	ND	ND	0.0067	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	mg/kg	100	500	1000	0.0017	0.0021	0.0025	0.0028	ND	ND	0.0019	0.0016	0.0013	0.0015	0.0017	0.002	ND	ND	ND	ND	ND	ND	0.0017	0.0022	ND	ND	0.0015	0.0021	0.0017	0.0022
Semivolatiles By SW 8270																														
Benz(a)anthracene	mg/kg	1	5.6	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	mg/kg	1	1	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	mg/kg	1	5.6	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(ghi)perylene	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	mg/kg	3.9	56	110	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl butyl phthalate	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	0.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0097	ND	ND	ND	ND	ND	0.024	ND	ND	ND	ND	ND	ND	0.02
Chrysene	mg/kg	3.9	56	110	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	mg/kg	0.33	0.56	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butylphthalate	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	ND	0.18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	mg/kg	0.5	5.6	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	0.16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.024	ND	ND	ND	ND	ND	ND	ND
Pyrene	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	ND	0.17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides - Soil By SW8081																														
Toxaphene	mg/Kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	mg/kg	0.2	1.4	2.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
- This table shows compounds only where results were found in analyticals. For full analytical results, refer to Appendix H. Laboratory Analytical Reports.
- This table shows results for Total Chromium.
- Less than Reporting Level (RL) is shown as ND.

Result Exceeds Criteria (Industrial) 🟥

G. C Environmental, Inc Job Address: Bush Terminal Units 39, 40 & 45 5102 First Avenue Brooklyn, New York 11232 Project Id : 13-246-00	Lab Sample Id Collection Date Client Id Matrix Units	*6 NYCRR* *Part 375* *Table 375-6.8 (b)* *Restricted Use Soil* *Cleanup Objectives* **Restricted Residential**	*6 NYCRR* *Part 375* *Table 375-6.8 (b)* *Restricted Use Soil* *Cleanup Objectives* **Commercial**	*6 NYCRR* *Part 375* *Table 375-6.8 (b)* *Restricted Use Soil* *Cleanup Objectives* **Industrial**	BF64622 10/15/2013 SB-14 (0-2) DUP Solid Result	BF64623 10/15/2013 SB-14 (5-10) DUP Solid Result	BF64596 10/14/2013 SB-15 (0-2) Solid Result	BF64597 10/14/2013 SB-15 (5-10) Solid Result	BF52602 10/9/2013 SB-16 0-2 FT Soil Result	BF52603 10/9/2013 SB-16 7-10 FT Soil Result	BF52604 10/9/2013 SB-17 0-2 FT Soil Result	BF52605 10/9/2013 SB-17 7-10 FT Soil Result	BF64018 10/11/2013 SB-20 (0-2) Soil Result	BF64019 10/11/2013 SB-20 (5-10) Soil Result	BF64592 10/14/2013 SB-21 (0-2) Solid Result	BF64593 10/14/2013 SB-21 (5-10) Solid Result	BF64602 10/14/2013 SB-22 Solid Result
Metals, Total																	
Aluminum	mg/Kg	ns	ns	ns	3,100	2,890	4,970	2,230	9,000	3,830	6,350	3,100	6,470	6,090	3,730	2,980	7,830
Antimony	mg/Kg	ns	ns	ns	ND	ND	ND	ND	1.6	ND	ND	ND	1.7	ND	ND	ND	ND
Arsenic	mg/Kg	16	16	16	1	1.3	3.3	2	4.8	2.8	2	1	4.3	4.8	1.3	1.1	3.7
Barium	mg/Kg	400	400	10,000	22.5	28.2	57.4	7.6	40.9	12.2	41.2	27.2	29.8	41.1	29	15	15.9
Beryllium	mg/Kg	72	72	2700	0.21	0.3	0.28	ND	0.48	0.31	0.39	0.25	0.4	0.36	0.28	0.18	0.38
Cadmium	mg/Kg	4.3	4.3	60	0.2	0.21	0.62	ND	0.4	0.17	0.22	ND	0.24	0.23	0.16	ND	0.25
Calcium	mg/Kg	ns	ns	ns	1760	1920	641	621	7350	840	1720	1280	1,490	4,780	7,120	5,050	687
Chromium	mg/Kg	ns	ns	ns	8.14	11.6	12.1	10.4	16.5	8.83	12.5	6.64	12.7	12.3	8.48	5.3	12
Cobalt	mg/Kg	ns	ns	ns	2.8	3.39	7.12	4.76	6.47	3.36	5.42	2.55	6.03	5.87	3.55	2.19	5.45
Copper	mg/kg	270	270	10,000	11.2	9.31	22.7	7.56	20.1	8.19	12.8	8.82	11.6	20.8	10.8	6.93	11.4
Iron	mg/Kg	ns	ns	ns	8510	8240	13,100	7,960	17600	11600	14000	6730	14,600	14,600	8,020	5,780	15,800
Lead	mg/Kg	400	400	3900	10.5	11.3	71.2	5.5	18.3	3.2	5.2	2.7	12.1	28.7	7	2.7	4.6
Magnesium	mg/Kg	ns	ns	ns	1,790	1,880	2,890	6,930	3,050	1700	3,200	1,940	1,810	3,430	3,020	2,210	3,490
Manganese	mg/Kg	2,000	2,000	10,000	163	199	349	138	282	168	289	166	244	196	202	204	230
Mercury	mg/Kg	0.81	0.81	5.7	ND	ND	0.25	ND	ND	ND	ND	ND	ND	0.08	ND	ND	ND
Nickel	mg/Kg	310	310	10,000	7.7	8.21	23.5	65.8	20.8	8.61	13.4	8.68	14.1	13.6	13.3	7.29	23.6
Potassium	mg/Kg	ns	ns	ns	679	709	1,180	439	1480	722	1910	745	1,060	1,390	996	685	849
Selenium	mg/Kg	180	180	6800	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	mg/Kg	180	180	6800	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	mg/Kg	ns	ns	ns	174	157	393	172	226	119	954	142	84	239	157	111	186
Thallium	mg/Kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	mg/Kg	ns	ns	ns	12.7	14.5	18.7	8.3	22.4	13.3	17.9	8.4	19.2	20.7	13.6	8.3	17.5
Zinc	mg/Kg	10,000	10,000	10,000	19.9	25.6	57.1	13.7	45.8	22.8	26.5	16	28.6	31.1	22.3	14	28.9
SVOA TICS																	
2-Pentanone, 4-hydroxy-4-methyl- (RT 3.370)	mg/kg	ns	ns	ns	ND	ND	ND	ND	2.5	ND	1.5	ND	1.5	1.7	ND	ND	ND
unknown (RT 3.280)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.045)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 1.370)	mg/kg	ns	ns	ns	ND	ND	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 14.730)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 17.700)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 19.720)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 20.000)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.000)	mg/kg	ns	ns	ns	ND	3.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.010)	mg/kg	ns	ns	ns	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	1.2
2-Pentanone, 4-hydroxy-4-methyl- (RT 5.020)	mg/kg	ns	ns	ns	2.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo[j]fluoranthene (RT 21.190)	mg/kg	ns	ns	ns	ND	ND	0.76	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 17.260)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 3.170)	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCBs By SW 8082																	
PCB-1268	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1260	mg/kg	ns	ns	ns	ND	ND	0.28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatiles By SW8260																	
Acetone	mg/kg	100	500	1000	0.0066	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8
Methyl ethyl ketone	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	mg/kg	100	500	1000	0.0023	0.0029	0.002	0.0025	ND	ND	ND	ND	0.0017	0.0021	0.0023	0.0025	0.0023
Semivolatiles By SW 8270																	
Benz(a)anthracene	mg/kg	1	5.6	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.56	ND	ND
Benzo(a)pyrene	mg/kg	1	1	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.62	ND	ND
Benzo(b)fluoranthene	mg/kg	1	5.6	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.74	ND	ND
Benzo(ghi)perylene	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.47	ND	ND
Benzo(k)fluoranthene	mg/kg	3.9	56	110	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.23	ND	ND
Benzyl butyl phthalate	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	mg/kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	mg/kg	3.9	56	110	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.6	ND	ND
Dibenz(a,h)anthracene	mg/kg	0.33	0.56	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.11	ND	ND
Di-n-butylphthalate	mg/kg	ns	ns	ns	ND	ND	ND	0.017	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	mg/kg	0.5	5.6	11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.34	ND	ND
Phenanthrene	mg/kg	100	500	1000	ND	0.2	ND	ND	ND	ND	ND	ND	ND	ND	0.1	ND	ND
Pyrene	mg/kg	100	500	1000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	ND	ND
Pesticides - Soil By SW8081																	
Toxaphene	mg/Kg	ns	ns	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	mg/kg	0.2	1.4	2.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:
- This table shows compounds only where results were found in analyticals. For full analytical results, refer to Appendix H. Laboratory Analytical Reports.
- This table shows results for Total Chromium.
- Less than Reporting Level (RL) is shown as ND.

Result Exceeds Criteria (Industrial) 🟥

TABLE 2 - GROUNDWATER ANALYTICAL DATA SUMMARY

G. C Environmental, Inc Job Address; Bush Terminal Units 39, 40 & 45 5102 First Avenue Brooklyn, New York Project Id : 13-246-00	Lab Sample Id Collection Date Client Id Matrix Units	*NYSDEC Ambient Water Quality Guidance* **TOGS-WQ/GA**	BF64052 10/14/2013 MW-1/SB-9 Ground Water Result	BF64053 10/14/2013 MW-2/SB-10 Ground Water Result	BF64054 10/14/2013 MW-3/SB-11 Ground Water Result	BF64055 10/14/2013 MW-4/SB-12 Ground Water Result	BF64056 10/14/2013 MW-5/SB-13 Ground Water Result	BF64625 10/15/2013 MW-6/SB-14 Ground Water Result	BF64624 10/15/2013 MW-7/SB-15 Ground Water Result	BF52606 41556 MW-8/SB-16 Ground Water Result	BF52607 41554 MW-9/SB-17 Ground Water Result	BF64057 10/14/2013 MW-1/SB-9 DUP Ground Water Result	BF64626 10/15/2013 TRIP BLANK 1 Ground Water Result	BF64627 10/15/2013 TRIP BLANK 2 Water Result	BF64628 41562 TRIP BLANK 3 Water Result
Metals, Total															
Aluminum (Dissolved)	mg/L	0.1	2.07	0.21	0.28	6.2	0.19	0.49	6.76	9.72	3.28	1.85	ND	ND	ND
Antimony, (Dissolved)	mg/L	0.003	ND	0.009	ND	ND	ND	0.045	ND	0.007	0.006	ND	ND	ND	ND
Arsenic, (Dissolved)	mg/L	0.025	0.004	0.003	0.004	0.001	0.003	0.004	0.009	0.001	0.007	0.002	ND	ND	ND
Barium (Dissolved)	mg/L	1	0.044	0.094	0.211	0.023	0.065	0.081	.142	0.257	0.304	0.038	ND	ND	ND
Beryllium (Dissolved)	mg/L	0.003	0.002	ND	ND	ND	ND	ND	0.002	0.002	0.001	ND	ND	ND	ND
Cadmium (Dissolved)	mg/L	0.005	0.001	0.001	ND	ND	ND	0	ND	0.001	ND	ND	ND	ND	ND
Calcium (Dissolved)	mg/L		506	60.3	79	37.6	27.3	73.2	53.5	392	74.5	475	ND	ND	ND
Chromium (Dissolved)	mg/L	0.05	0.003	ND	ND	0.006	0.003	0.002	0.021	0.039	0.011	0.002	ND	ND	ND
Cobalt, (Dissolved)	mg/L		0.005	0.004	0.002	ND	ND	0.001	0.022	0.02	0.005	0.005	ND	ND	ND
Copper, (Dissolved)	mg/L	0.2	0.005	0.005	0.003	0.01	0.003	.013	0.083	0.068	0.031	0.005	ND	ND	ND
Iron, (Dissolved)	mg/L	0.3	2.17	0.22	0.46	3.22	0.25	0.59	9.58	5.1	2.53	2.4	ND	ND	ND
Lead (Dissolved)	mg/L	0.025	0.002	ND	0.001	0.009	ND	0.002	.515	0.056	.004	ND	ND	ND	ND
Magnesium (Dissolved)	mg/L	35	35.6	6.1	20.8	4.57	1.85	12	8.58	32.7	19.2	34.5	ND	ND	ND
Manganese, (Dissolved)	mg/L	0.3	0.706	7.7	7.47	1.95	0.021	0.031	2.39	1.39	1.01	0.692	ND	ND	ND
Mercury (Dissolved)	mg/L	0.0007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel, (Dissolved)	mg/L	0.1	0.013	0.032	0.007	0.006	0.003	0.005	0.048	0.035	0.019	0.013	ND	ND	ND
Potassium (Dissolved)	mg/L		17.8	5.7	8	11.4	9.6	12.5	16.9	11.7	7.4	17.2	ND	ND	ND
Selenium, (Dissolved)	mg/L	0.01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver (Dissolved)	mg/L	0.05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium (Dissolved)	mg/L	20	279	131	91.5	156	250	104	221	126	152	260	ND	ND	ND
Thallium , (Dissolved)	mg/L	0.0005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium, (Dissolved)	mg/L		0.01	ND	0.0005	0.01	0.0029	ND	0.04	0.02	0.01	0.004	ND	ND	ND
Zinc, (Dissolved)	mg/L	5	0.014	0.116	0.007	0.019	0.003	0.01	0.128	0.129	0.042	0.015	ND	ND	ND
SVOA TICS															
unknown (RT 10.560)	ug/L	ns	ND	19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 10.680)	ug/L	ns	ND	23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 12.643)	ug/L	ns	ND	ND	10,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 12.930)	ug/L	ns	ND	8.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 13.140)	ug/L	ns	ND	4.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 13.601)	ug/L	ns	ND	ND	40,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 14.290)	ug/L	ns	ND	6.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 14.590)	ug/L	ns	ND	5.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 14.650)	ug/L	ns	ND	16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 15.340)	ug/L	ns	ND	ND	72,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 16.130)	ug/L	ns	ND	ND	130,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 16.411)	ug/L	ns	ND	ND	210,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 17.732)	ug/L	ns	ND	ND	13,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 4.960)	ug/L	ns	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.8	ND	ND	ND
unknown (RT 4.970)	ug/L	ns	ND	ND	ND	6.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 6.105)	ug/L	ns	ND	ND	190,000	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 6.770)	ug/L	ns	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 7.200)	ug/L	ns	ND	ND	ND	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
unknown (RT 5.997)	ug/L	ns	ND	ND	ND	ND	ND	ND	11	ND	ND	ND	ND	ND	ND
unknown (RT 7.756)	ug/L	ns	ND	ND	ND	ND	ND	19	ND	ND	ND	ND	ND	ND	ND
unknown (RT 8.131)	ug/L	ns	ND	ND	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	ND
PCBs By 8082			ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Volatiles By SW8260															
Acetone	ug/L	50	6.6	9.2	7.5	5.9	4.6	13	2.5	3.5	ND	6.1	ND	2	2.5
Carbon Disulfide	ug/L		ND	ND	ND	ND	ND	ND	ND	0.43	ND	ND	ND	ND	ND
Chloromethane	ug/L		ND	ND	ND	ND	ND	0.888	ND	ND	ND	ND	ND	ND	ND
Methyl ethyl ketone	ug/L	50	ND	1.6	ND	1.8	0.97		ND	0.86	ND	1.4	1.1	0.71	ND
Methyl t-butyl ether (MTBE)	ug/L		ND	3.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	ug/L	5	ND	ND	ND	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ug/L	5	ND	ND	ND	ND	ND	ND	ND	3.3	4.6	ND	ND	ND	ND
Semivolatiles By SW 8270(SIM)															
Benz(a)anthracene	ug/L	0.002	0.03	0.03	ND	0.11	ND	0.04	0.22	0.03	0.021	ND	ND	ND	ND
Benzo(a)pyrene	ug/L		ND	ND	ND	0.05	ND	ND	0.15	ND	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ug/L	0.002	ND	ND	ND	0.08	ND	0.03	0.26	ND	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ug/L	0.002	ND	ND	ND	0.03	ND	ND	0.07	ND	ND	ND	ND	ND	ND
Chrysene	ug/L	0.002	0.02	ND	ND	0.09	ND	0.03	0.21	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ug/L		ND	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ug/L	0.002	ND	ND	ND	0.03	ND	ND	0.08	ND	ND	ND	ND	ND	ND
Phenanthrene	ug/L	50	0.16	ND	0.23	0.75	ND	ND	0.14	0.09	ND	0.18	ND	ND	ND
Benzyl butyl phthalate	ug/L		ND	ND	ND	ND	ND	ND	2.6	ND	ND	ND	ND	ND	ND
Pesticides By SW8081	ug/L														
Dieldrin	ug/L	0.004	ND	ND	ND	ND	ND	ND	0.006	ND	ND	ND	ND	ND	ND

Notes:
- This table shows compounds only where results were found in analyticals. For full analytical results, refer to Appendix H. Laboratory Analytical Reports.
- This table shows results for Total Chromium.
- Less than Reporting Level (RL) is shown as ND.

Result Detected 🟪

Result Exceeds Criteria (TOGS) 🟥

TABLE 3 - SOIL VAPOR ANALYTICAL DATA SUMMARY

G.C. Environmental, Inc Job Address: BTU 39, 40 & 45 Brooklyn, New York Project Id : 13-246-00	Lab Sample Id Collection Date Client Id Matrix Units	**NYSDOH CEH BEEI Guidance**	BF64603 10/15/2013 SSV-3 Air Result	BF64604 10/15/2013 SSV-1 Air Result	BF64605 10/15/2013 SSV-2 Air Result	BF64607 10/15/2013 SV-5 Air Result	BF64608 10/15/2013 OA-1 Air Result	BF64609 10/15/2013 SV-1 Air Result	BF66839 10/21/2013 SV-2 Air Result	BF64610 10/15/2013 SV-3 Air Result
Volatiles (TO15) By TO15										
1,2,4-Trimethylbenzene	ug/m3		311	23.9	94.3	22.1	ND	32.4	29.9	26.7
1,3,5-Trimethylbenzene	ug/m3		105		51.6	6.14	ND	8.84	20	7.07
2-Hexanone(MBK)	ug/m3		11.8	ND	ND	ND	ND	4.75	ND	4.71
4-Ethyltoluene	ug/m3		31.2	3.88	19.7	3.73	ND	4.22	18.2	5.11
4-Isopropyltoluene	ug/m3		17.7	2.41	5.38	2.03	ND	2.69	2.41	2.47
4-Methyl-2-pentanone(MIBK)	ug/m3		4.95	1.35	3.23	1.39	ND	6.71	ND	1.1
Acetone	ug/m3		214	223	377	498	15.5	406	256	420
Benzene	ug/m3		1.72	5.65	4.09	1.31	1.5	1.47	37.7	1.37
Bromoform	ug/m3		1.24	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	ug/m3		1.4	5.13	1.21	ND	ND	2.12	1.12	2.36
Carbon Tetrachloride	ug/m3		0.503	1.19	0.503	0.251	0.503	0.629	0.754	ND
Chloroform	ug/m3		1.22	ND	ND	ND	ND	ND	1.02	2.88
Chloromethane	ug/m3		1.03	1.16	ND	ND	ND	1.22	ND	ND
Cyclohexane	ug/m3		ND	10.4	4.58	ND	ND	ND	664	2.86
Dichlorodifluoromethane	ug/m3		2.32	2.32	2.08	2.12	2.22	2.32	ND	2.27
Ethanol	ug/m3		527	142	35	34.1	21.6	98.7	129	12.3
Ethyl acetate	ug/m3		ND	28	ND	ND	ND	1.55	ND	ND
Ethylbenzene	ug/m3		18.3	22.2	26.4	3.3	ND	3.82	127	3.12
Heptane	ug/m3		5.36	16.2	7.99	2.58	4.3	1.92	491	2.01
Hexane	ug/m3		3.52	74.7	9.93	3.49	2.82	2.46	553	6.16
Isopropylalcohol	ug/m3		21.4	7.22	21.3	3.98	4.99	6.63	ND	3.29
Isopropylbenzene	ug/m3		15	2.01	14.7	1.13	ND	1.23	31.4	1.13
m,p-Xylene	ug/m3		72	79	98.9	11.7	2.13	13.9	159	12.3
Methyl Ethyl Ketone	ug/m3		86.6	62.8	42.4	33.6	2.59	37.1	ND	15.6
Methylene Chloride	ug/m3	60	17.5	62.8	11.6	13.3	9.34	9.44	ND	8.02
n-Butylbenzene	ug/m3		117	7.02	12.4	6.03	ND	9.71	4.88	7.35
o-Xylene	ug/m3		48.2	40.2	57.3	5.9	ND	7.07	139	6.38
Propylene	ug/m3		3.65	9.58	5.54	8.26	2.37	5.44	ND	7.81
sec-Butylbenzene	ug/m3		12	1.81	13.7	2.14	ND	2.47	14.6	1.48
Styrene	ug/m3		2	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ug/m3	100	2.37	3.12	37.5	138	4.88	1.56	75.2	350
Tetrahydrofuran	ug/m3		38.3	78.1	40.1	3.21	ND	15.6	ND	10.2
Toluene	ug/m3		14.3	91.9	29.2	9.9	5.01	11.7	190	10.2
Trichloroethene	ug/m3	5	0.322	1.4	0.644	ND	ND	10.5	607	0.537
Trichlorofluoromethane	ug/m3		1.29	1.29	1.18	1.4	1.18	1.18	1.74	1.57

- Less than Reporting Level (RL) is shown as ND.

Result Exceeds Criteria (BEEI) 🟥

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	TRC-SB-01 (0-2)		TRC-SB-01 (4-6)		TRC-SB-02 (0-2)		TRC-SB-02 (4-6)		TRC-SB-03 (0-2)		TRC-SB-03 (5-7)		TRC-SB-04 (0-2)		TRC-SB-04 (5-7)	
				LABORATORY SAMPLE ID:	AD16013-003		AD16013-004		AD16071-001		AD16071-002		AD16071-003		AD16071-004		AD16071-005		AD16071-006	
				DATE SAMPLE COLLECTED:	3/3/2020		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1,1-Trichloroethane	0.68	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,1,2,2-Tetrachloroethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,1,2-Trichloroethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,1-Dichloroethane	0.27	26	240	480	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,1-Dichloroethene	0.33	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,2,3-Trichlorobenzene	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,2,4-Trichlorobenzene	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,2,4-Trimethylbenzene	3.6/3.6	52	190	380	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,2-Dibromoethane	NC	NC	NC	NC	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00074	U
1,2-Dichlorobenzene	1.1	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,2-Dichloroethane	0.02	3.1	30	60	0.0016	U	0.0019	U	0.0016	U	0.0021	U	0.0018	U	0.0019	U	0.0017	U	0.0019	U
1,2-Dichloropropane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,3,5-Trimethylbenzene	8.4/8.4	52	190	380	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
1,3-Dichlorobenzene	2.4	49	280	560	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,4-Dichlorobenzene	1.8	13	130	250	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
1,4-Dioxane	0.1	13	130	250	0.100	U	0.120	U	0.100	U	0.140	U	0.110	U	0.120	U	0.110	U	0.095	U
2-Butanone	0.12	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
2-Hexanone	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
4-Isopropyltoluene	NC/10	NC	NC	NC	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
4-Methyl-2-pentanone	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Acetone	0.05	100	500	1,000	0.010	U	0.012	U	0.010	U	0.014	U	0.011	U	0.012	U	0.011	U	0.0095	U
Benzene	0.06/0.06	4.8	44	89	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
Bromochloromethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Bromodichloromethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Bromoform	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Bromomethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Carbon disulfide	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	TRC-SB-01 (0-2)		TRC-SB-01 (4-6)		TRC-SB-02 (0-2)		TRC-SB-02 (4-6)		TRC-SB-03 (0-2)		TRC-SB-03 (5-7)		TRC-SB-04 (0-2)		TRC-SB-04 (5-7)	
				LABORATORY SAMPLE ID:	AD16013-003		AD16013-004		AD16071-001		AD16071-002		AD16071-003		AD16071-004		AD16071-005		AD16071-006	
				DATE SAMPLE COLLECTED:	3/3/2020		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Carbon tetrachloride	0.76	2.4	22	44	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Chlorobenzene	1.1	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Chloroethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Chloroform	0.37	49	350	700	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Chloromethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
cis-1,2-Dichloroethene	0.25	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
cis-1,3-Dichloropropene	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Cyclohexane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Dibromochloromethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Dichlorodifluoromethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Ethylbenzene	1/1	41	390	780	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
Isopropylbenzene	NC/2.3	NC	NC	NC	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
m&p-Xylenes(1)	NC	NC	NC	NC	0.001	U	0.0029		0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
Methyl Acetate	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Methylcyclohexane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Methylene chloride	0.05	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0029		0.0019	U
Methyl-t-butyl ether	0.93/0.93	100	500	1,000	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
n-Butylbenzene	12/12	100	500	1,000	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
n-Propylbenzene	3.9/3.9	100	500	1,000	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
o-Xylene(1)	NC	NC	NC	NC	0.001	U	0.0013		0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
sec-Butylbenzene	11/11	100	500	1,000	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
Styrene	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
t-Butylbenzene	5.9/5.9	100	500	1,000	0.001	U	0.0012	U	0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U
Tetrachloroethene	1.3	19	150	300	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Toluene	0.7/0.7	100	500	1,000	0.001	U	0.0012	U	0.001	U	0.0014	U	0.023		0.0012	U	0.0011	U	0.00095	U
trans-1,2-Dichloroethene	0.19	100	500	1,000	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
trans-1,3-Dichloropropene	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Trichloroethene	0.47	21	200	400	0.002	U	0.0024	U	0.002	U	0.0027	U	0.015		0.0063		0.0022	U	0.0019	U
Trichlorofluoromethane	NC	NC	NC	NC	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Vinyl chloride	0.02	0.9	13	27	0.002	U	0.0024	U	0.002	U	0.0027	U	0.0023	U	0.0024	U	0.0022	U	0.0019	U
Xylenes (Total)	0.26/0.26	100	500	1,000	0.001	U	0.0042		0.001	U	0.0014	U	0.0011	U	0.0012	U	0.0011	U	0.00095	U

Notes

(1) - There is no SCO, SSCO, or SCL for m/p-xylene or o-xylene.
The SCO/SCL for total xylenes is 0.26 mg/kg.

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	**TRC-SB-05 (0-2)**		**TRC-SB-05 (5-7)**		**TRC-SB-06 (0-2)**		**TRC-SB-06 (6-8)**		**TRC-SB-07 (0-2)**		**TRC-SB-07 (4-6)**		**TRC-SB-08 (0-2)**		**TRC-SB-08 (6-8)**	
				LABORATORY SAMPLE ID:	AD16041-010		AD16041-011		AD16095-007		AD16095-008		AD16095-003		AD16095-004		AD16013-005		AD16013-006	
				DATE SAMPLE COLLECTED:	3/4/2020		3/4/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020		3/3/2020		3/3/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1,1-Trichloroethane	0.68	100	500	1,000	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,1,2,2-Tetrachloroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,1,2-Trichloroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,1-Dichloroethane	0.27	26	240	480	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,1-Dichloroethene	0.33	100	500	1,000	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,2,3-Trichlorobenzene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,2,4-Trichlorobenzene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,2,4-Trimethylbenzene	3.6/3.6	52	190	380	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,2-Dibromoethane	NC	NC	NC	NC	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
1,2-Dichlorobenzene	1.1	100	500	1,000	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,2-Dichloroethane	0.02	3.1	30	60	0.0018	U	0.0016	U	0.0018	U	0.0018	U	0.0017	U	0.0017	U	0.0019	U	0.0015	U
1,2-Dichloropropane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,3,5-Trimethylbenzene	8.4/8.4	52	190	380	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
1,3-Dichlorobenzene	2.4	49	280	560	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,4-Dichlorobenzene	1.8	13	130	250	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
1,4-Dioxane	0.1	13	130	250	0.120	U	0.100	U	0.120	U	0.120	U	0.110	U	0.110	U	0.120	U	0.096	U
2-Butanone	0.12	100	500	1,000	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
2-Hexanone	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
4-Isopropyltoluene	NC/10	NC	NC	NC	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
4-Methyl-2-pentanone	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Acetone	0.05	100	500	1,000	0.012	U	0.010	U	0.012	U	0.012	U	0.011	U	0.011	U	0.012	U	0.0096	U
Benzene	0.06/0.06	4.8	44	89	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
Bromochloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Bromodichloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Bromoform	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Bromomethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Carbon disulfide	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

SAMPLE ID:					**TRC-SB-05 (0-2)**		**TRC-SB-05 (5-7)**		**TRC-SB-06 (0-2)**		**TRC-SB-06 (6-8)**		**TRC-SB-07 (0-2)**		**TRC-SB-07 (4-6)**		**TRC-SB-08 (0-2)**		**TRC-SB-08 (6-8)**	
LABORATORY SAMPLE ID:					AD16041-010		AD16041-011		AD16095-007		AD16095-008		AD16095-003		AD16095-004		AD16013-005		AD16013-006	
DATE SAMPLE COLLECTED:					3/4/2020		3/4/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020		3/3/2020		3/3/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Carbon tetrachloride	0.76	2.4	22	44	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Chlorobenzene	1.1	100	500	1,000	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Chloroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Chloroform	0.37	49	350	700	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Chloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
cis-1,2-Dichloroethene	0.25	100	500	1,000	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
cis-1,3-Dichloropropene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Cyclohexane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Dibromochloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Dichlorodifluoromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Ethylbenzene	1/1	41	390	780	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
Isopropylbenzene	NC/2.3	NC	NC	NC	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
m&p-Xylenes(1)	NC	NC	NC	NC	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
Methyl Acetate	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Methylcyclohexane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Methylene chloride	0.05	100	500	1,000	0.0023	U	0.0023		0.0024	U	0.0023	U	0.0022	U	0.0049		0.0025	U	0.0023	U
Methyl-t-butyl ether	0.93/0.93	100	500	1,000	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
n-Butylbenzene	12/12	100	500	1,000	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
n-Propylbenzene	3.9/3.9	100	500	1,000	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
o-Xylene(1)	NC	NC	NC	NC	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
sec-Butylbenzene	11/11	100	500	1,000	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
Styrene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
t-Butylbenzene	5.9/5.9	100	500	1,000	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
Tetrachloroethene	1.3	19	150	300	0.0038		0.240		0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Toluene	0.7/0.7	100	500	1,000	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U
trans-1,2-Dichloroethene	0.19	100	500	1,000	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
trans-1,3-Dichloropropene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Trichloroethene	0.47	21	200	400	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Trichlorofluoromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Vinyl chloride	0.02	0.9	13	27	0.0023	U	0.0021	U	0.0024	U	0.0023	U	0.0022	U	0.0022	U	0.0025	U	0.0019	U
Xylenes (Total)	0.26/0.26	100	500	1,000	0.0012	U	0.001	U	0.0012	U	0.0012	U	0.0011	U	0.0011	U	0.0012	U	0.00096	U

Notes

(1) - There is no SCO, SSCO, or SCL for m/p-xylene or o-xylene.
The SCO/SCL for total xylenes is 0.26 mg/kg.

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

SAMPLE ID:					TRC-SB-09 (0-2)		TRC-SB-09 (4-6)		TRC-SB-10 (0-2)		TRC-SB-10 (4-6)		TRC-SB-11 (0-2)		TRC-SB-11 (4-6)		TRC-SB-12 (0-2)		TRC-SB-12 (3-5)	
LABORATORY SAMPLE ID:					AD16013-001		AD16013-002		AD16041-008		AD16041-009		AD16071-007		AD16071-008		AD16041-003		AD16041-004	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/5/2020		3/5/2020		3/4/2020		3/4/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1,1-Trichloroethane	0.68	100	500	1,000	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,1,2,2-Tetrachloroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,1,2-Trichloroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,1-Dichloroethane	0.27	26	240	480	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,1-Dichloroethene	0.33	100	500	1,000	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,2,3-Trichlorobenzene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,2,4-Trichlorobenzene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,2,4-Trimethylbenzene	3.6/3.6	52	190	380	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,2-Dibromoethane	NC	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.00078	U	0.001	U	0.0013	U	0.0012	U
1,2-Dichlorobenzene	1.1	100	500	1,000	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,2-Dichloroethane	0.02	3.1	30	60	0.0016	U	0.0018	U	0.0019	U	0.0017	U	0.002	U	0.0026	U	0.002	U	0.0019	U
1,2-Dichloropropane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,3,5-Trimethylbenzene	8.4/8.4	52	190	380	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
1,3-Dichlorobenzene	2.4	49	280	560	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,4-Dichlorobenzene	1.8	13	130	250	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
1,4-Dioxane	0.1	13	130	250	0.110	U	0.120	U	0.120	U	0.110	U	0.100	U	0.130	U	0.130	U	0.120	U
2-Butanone	0.12	100	500	1,000	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
2-Hexanone	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
4-Isopropyltoluene	NC/10	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
4-Methyl-2-pentanone	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Acetone	0.05	100	500	1,000	0.011	U	0.012	U	0.012	U	0.011	U	0.01	U	0.013	U	0.013	U	0.012	U
Benzene	0.06/0.06	4.8	44	89	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
Bromochloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Bromodichloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Bromoform	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Bromomethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Carbon disulfide	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	TRC-SB-09 (0-2)		TRC-SB-09 (4-6)		TRC-SB-10 (0-2)		TRC-SB-10 (4-6)		TRC-SB-11 (0-2)		TRC-SB-11 (4-6)		TRC-SB-12 (0-2)		TRC-SB-12 (3-5)	
				LABORATORY SAMPLE ID:	AD16013-001		AD16013-002		AD16041-008		AD16041-009		AD16071-007		AD16071-008		AD16041-003		AD16041-004	
				DATE SAMPLE COLLECTED:	3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/5/2020		3/5/2020		3/4/2020		3/4/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Carbon tetrachloride	0.76	2.4	22	44	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Chlorobenzene	1.1	100	500	1,000	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Chloroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Chloroform	0.37	49	350	700	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Chloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
cis-1,2-Dichloroethene	0.25	100	500	1,000	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
cis-1,3-Dichloropropene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Cyclohexane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Dibromochloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Dichlorodifluoromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Ethylbenzene	1/1	41	390	780	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
Isopropylbenzene	NC/2.3	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
m&p-Xylenes[1]	NC	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
Methyl Acetate	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Methylcyclohexane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Methylene chloride	0.05	100	500	1,000	0.0021	U	0.0023	U	0.0027		0.0021	U	0.0021		0.0042		0.0026	U	0.0029	U
Methyl-t-butyl ether	0.93/0.93	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
n-Butylbenzene	12/12	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
n-Propylbenzene	3.9/3.9	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
o-Xylene[1]	NC	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
sec-Butylbenzene	11/11	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
Styrene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
t-Butylbenzene	5.9/5.9	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
Tetrachloroethene	1.3	19	150	300	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.003		0.022		0.0026	U	0.0024	U
Toluene	0.7/0.7	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U
trans-1,2-Dichloroethene	0.19	100	500	1,000	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
trans-1,3-Dichloropropene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Trichloroethene	0.47	21	200	400	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Trichlorofluoromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Vinyl chloride	0.02	0.9	13	27	0.0021	U	0.0023	U	0.0025	U	0.0021	U	0.002	U	0.0026	U	0.0026	U	0.0024	U
Xylenes (Total)	0.26/0.26	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0011	U	0.001	U	0.0013	U	0.0013	U	0.0012	U

Notes

[1] - There is no SCO, SSCO, or SCL for m/p-xylene or o-xylene.
The SCO/SCL for total xylenes is 0.26 mg/kg.

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	TRC-SB-13 (0-2)		TRC-SB-13 (6-8)		TRC-SB-14 (0-2)		TRC-SB-14 (4-6)		TRC-SB-15 (0-2)		TRC-SB-15 (9-11)		TRC-SB-16 (0-2)		TRC-SB-16 (8-10)	
				LABORATORY SAMPLE ID:	AD16071-009		AD16071-010		AD16095-001		AD16095-002		AD16095-005		AD16095-006		AD16107-005		AD16107-006	
				DATE SAMPLE COLLECTED:	3/5/2020		3/5/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020		3/9/2020		3/9/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1,1-Trichloroethane	0.68	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,1,2,2-Tetrachloroethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,1,2-Trichloroethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,1-Dichloroethane	0.27	26	240	480	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,1-Dichloroethene	0.33	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,2,3-Trichlorobenzene	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,2,4-Trichlorobenzene	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,2,4-Trimethylbenzene	3.6/3.6	52	190	380	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,2-Dibromoethane	NC	NC	NC	NC	0.00085	U	0.00086	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
1,2-Dichlorobenzene	1.1	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,2-Dichloroethane	0.02	3.1	30	60	0.0022	U	0.0022	U	0.0017	U	0.0015	U	0.0017	U	0.0021	U	0.0015	U	0.0018	U
1,2-Dichloropropane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,3,5-Trimethylbenzene	8.4/8.4	52	190	380	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
1,3-Dichlorobenzene	2.4	49	280	560	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,4-Dichlorobenzene	1.8	13	130	250	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
1,4-Dioxane	0.1	13	130	250	0.110	U	0.110	U	0.110	U	0.095	U	0.110	U	0.130	U	0.095	U	0.110	U
2-Butanone	0.12	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0057		0.0022	U	0.0027	U	0.0019	U	0.0023	U
2-Hexanone	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
4-Isopropyltoluene	NC/10	NC	NC	NC	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
4-Methyl-2-pentanone	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Acetone	0.05	100	500	1,000	0.011	U	0.011	U	0.011	U	0.041		0.011	U	0.013	U	0.0095	U	0.011	U
Benzene	0.06/0.06	4.8	44	89	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
Bromochloromethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Bromodichloromethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Bromoform	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Bromomethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Carbon disulfide	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

SAMPLE ID:					**TRC-SB-13 (0-2)**		**TRC-SB-13 (6-8)**		**TRC-SB-14 (0-2)**		**TRC-SB-14 (4-6)**		**TRC-SB-15 (0-2)**		**TRC-SB-15 (9-11)**		**TRC-SB-16 (0-2)**		**TRC-SB-16 (8-10)**	
LABORATORY SAMPLE ID:					AD16071-009		AD16071-010		AD16095-001		AD16095-002		AD16095-005		AD16095-006		AD16107-005		AD16107-006	
DATE SAMPLE COLLECTED:					3/5/2020		3/5/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020		3/9/2020		3/9/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Carbon tetrachloride	0.76	2.4	22	44	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Chlorobenzene	1.1	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Chloroethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Chloroform	0.37	49	350	700	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Chloromethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
cis-1,2-Dichloroethene	0.25	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
cis-1,3-Dichloropropene	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Cyclohexane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Dibromochloromethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Dichlorodifluoromethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Ethylbenzene	1/1	41	390	780	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
Isopropylbenzene	NC/2.3	NC	NC	NC	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
m&p-Xylenes(1)	NC	NC	NC	NC	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
Methyl Acetate	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Methylcyclohexane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Methylene chloride	0.05	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0036		0.006		0.0019	U	0.0049	
Methyl-t-butyl ether	0.93/0.93	100	500	1,000	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
n-Butylbenzene	12/12	100	500	1,000	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
n-Propylbenzene	3.9/3.9	100	500	1,000	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
o-Xylene(1)	NC	NC	NC	NC	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
sec-Butylbenzene	11/11	100	500	1,000	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
Styrene	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
t-Butylbenzene	5.9/5.9	100	500	1,000	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
Tetrachloroethene	1.3	19	150	300	0.0028		0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Toluene	0.7/0.7	100	500	1,000	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U
trans-1,2-Dichloroethene	0.19	100	500	1,000	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
trans-1,3-Dichloropropene	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Trichloroethene	0.47	21	200	400	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Trichlorofluoromethane	NC	NC	NC	NC	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Vinyl chloride	0.02	0.9	13	27	0.0022	U	0.0022	U	0.0022	U	0.0019	U	0.0022	U	0.0027	U	0.0019	U	0.0023	U
Xylenes (Total)	0.26/0.26	100	500	1,000	0.0011	U	0.0011	U	0.0011	U	0.00095	U	0.0011	U	0.0013	U	0.00095	U	0.0011	U

Notes

(1) - There is no SCO, SSCO, or SCL for m/p-xylene or o-xylene.
The SCO/SCL for total xylenes is 0.26 mg/kg.

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	**TRC-SB-17 (0-2)**		**TRC-SB-17 (15-17)**		**TRC-SB-18 (0-2)**		**TRC-SB-18 (5-7)**		**TRC-SB-19 (0-2)**		**TRC-SB-19 (7-9)**		**TRC-SB-20 (0-2)**		**TRC-SB-20 (6-8)**	
				LABORATORY SAMPLE ID:	AD16013-007		AD16013-008		AD16041-001		AD16041-002		AD16041-006		AD16041-007		AD16107-007		AD16107-008	
				DATE SAMPLE COLLECTED:	3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1,1-Trichloroethane	0.68	100	500	1,000	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,1,2,2-Tetrachloroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,1,2-Trichloroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,1-Dichloroethane	0.27	26	240	480	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,1-Dichloroethene	0.33	100	500	1,000	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,2,3-Trichlorobenzene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,2,4-Trichlorobenzene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,2,4-Trimethylbenzene	3.6/3.6	52	190	380	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,2-Dibromoethane	NC	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
1,2-Dichlorobenzene	1.1	100	500	1,000	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,2-Dichloroethane	0.02	3.1	30	60	0.0017	U	0.0018	U	0.0018	U	0.0021	U	0.53	U	0.0026	U	0.0019	U	0.0014	U
1,2-Dichloropropane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,3,5-Trimethylbenzene	8.4/8.4	52	190	380	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
1,3-Dichlorobenzene	2.4	49	280	560	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,4-Dichlorobenzene	1.8	13	130	250	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
1,4-Dioxane	0.1	13	130	250	0.110	U	0.120	U	0.120	U	0.140	U	53.0	U	0.170	U	0.120	U	0.091	U
2-Butanone	0.12	100	500	1,000	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
2-Hexanone	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
4-Isopropyltoluene	NC/10	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
4-Methyl-2-pentanone	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0028	
Acetone	0.05	100	500	1,000	0.011	U	0.012	U	0.012	U	0.014	U	5.30	U	0.017	U	0.012	U	0.0091	U
Benzene	0.06/0.06	4.8	44	89	0.0011	U	0.0012	U	0.0012	U	0.0014	U	0.530	U	0.0017	U	0.0012	U	0.00091	U
Bromochloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Bromodichloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Bromoform	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Bromomethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Carbon disulfide	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U

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Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
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Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

SAMPLE ID:					**TRC-SB-17 (0-2)**		**TRC-SB-17 (15-17)**		**TRC-SB-18 (0-2)**		**TRC-SB-18 (5-7)**		**TRC-SB-19 (0-2)**		**TRC-SB-19 (7-9)**		**TRC-SB-20 (0-2)**		**TRC-SB-20 (6-8)**	
LABORATORY SAMPLE ID:					AD16013-007		AD16013-008		AD16041-001		AD16041-002		AD16041-006		AD16041-007		AD16107-007		AD16107-008	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Carbon tetrachloride	0.76	2.4	22	44	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Chlorobenzene	1.1	100	500	1,000	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Chloroethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Chloroform	0.37	49	350	700	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Chloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
cis-1,2-Dichloroethene	0.25	100	500	1,000	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
cis-1,3-Dichloropropene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Cyclohexane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Dibromochloromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Dichlorodifluoromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Ethylbenzene	1/1	41	390	780	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
Isopropylbenzene	NC/2.3	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
m&p-Xylenes[(1)]	NC	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
Methyl Acetate	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Methylcyclohexane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Methylene chloride	0.05	100	500	1,000	0.0021	U	0.0023	U	0.0049		0.0028		1.10	U	0.0038		0.0024	U	0.0018	U
Methyl-t-butyl ether	0.93/0.93	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0014	U	0.530	U	0.0017	U	0.0012	U	0.00091	U
n-Butylbenzene	12/12	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
n-Propylbenzene	3.9/3.9	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
o-Xylene[(1)]	NC	NC	NC	NC	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
sec-Butylbenzene	11/11	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
Styrene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
t-Butylbenzene	5.9/5.9	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
Tetrachloroethene	1.3	19	150	300	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Toluene	0.7/0.7	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U
trans-1,2-Dichloroethene	0.19	100	500	1,000	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
trans-1,3-Dichloropropene	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Trichloroethene	0.47	21	200	400	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Trichlorofluoromethane	NC	NC	NC	NC	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Vinyl chloride	0.02	0.9	13	27	0.0021	U	0.0023	U	0.0024	U	0.0028	U	1.10	U	0.0033	U	0.0024	U	0.0018	U
Xylenes (Total)	0.26/0.26	100	500	1,000	0.0011	U	0.0012	U	0.0012	U	0.0014	U	1.10	U	0.0017	U	0.0012	U	0.00091	U

Notes

[(1)] - There is no SCO, SSCO, or SCL for m/p-xylene or o-xylene.
The SCO/SCL for total xylenes is 0.26 mg/kg.

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	**TRC-SB-21 (0-2)**		**TRC-SB-21 (6-8)**		**TRC-SB-22 (0-2)**		**TRC-SB-22 (6-8)**		**TRC-DUP-01**		**TRC-DUP-02**		**TRC-DUP-03**	
				LABORATORY SAMPLE ID:	AD16107-001		AD16107-002		AD16107-003		AD16107-004		AD16041-005		AD16095-017		AD16107-009	
				DATE SAMPLE COLLECTED:	3/9/2020		3/9/2020		3/9/2020		3/9/2020		3/4/2020		3/6/2020		3/9/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1,1-Trichloroethane	0.68	100	500	1,000	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,1,2,2-Tetrachloroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,1,2-Trichloroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,1-Dichloroethane	0.27	26	240	480	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,1-Dichloroethene	0.33	100	500	1,000	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,2,3-Trichlorobenzene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,2,4-Trichlorobenzene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,2,4-Trimethylbenzene	3.6/3.6	52	190	380	0.0012	U	0.001	U	0.230		2.000		0.0013	U	0.0011	U	0.0012	U
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,2-Dibromoethane	NC	NC	NC	NC	0.0012	U	0.001	U	0.130	U	0.100	U	0.0013	U	0.0011	U	0.0012	U
1,2-Dichlorobenzene	1.1	100	500	1,000	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,2-Dichloroethane	0.02	3.1	30	60	0.0018	U	0.0016	U	0.063	U	0.052	U	0.002	U	0.0016	U	0.0019	U
1,2-Dichloropropane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,3,5-Trimethylbenzene	8.4/8.4	52	190	380	0.0012	U	0.001	U	0.240		0.730		0.0013	U	0.0011	U	0.0012	U
1,3-Dichlorobenzene	2.4	49	280	560	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,4-Dichlorobenzene	1.8	13	130	250	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
1,4-Dioxane	0.1	13	130	250	0.120	U	0.100	U	6.30	U	5.20	U	0.130	U	0.110	U	0.120	U
2-Butanone	0.12	100	500	1,000	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0036	
2-Hexanone	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
4-Isopropyltoluene	NC/10	NC	NC	NC	0.0012	U	0.001	U	0.130	U	0.100	U	0.0013	U	0.0011	U	0.0012	U
4-Methyl-2-pentanone	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Acetone	0.05	100	500	1,000	0.012	U	0.01	U	0.630	U	0.520	U	0.013	U	0.011	U	0.038	
Benzene	0.06/0.06	4.8	44	89	0.0012	U	0.001	U	0.063	U	0.052	U	0.0013	U	0.0011	U	0.0012	U
Bromochloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Bromodichloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Bromoform	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Bromomethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Carbon disulfide	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U

Table 1
Bush Terminal South Campus
New York City Economic Development Corporation
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

				SAMPLE ID:	TRC-SB-21 (0-2)		TRC-SB-21 (6-8)		TRC-SB-22 (0-2)		TRC-SB-22 (6-8)		TRC-DUP-01		TRC-DUP-02		TRC-DUP-03	
				LABORATORY SAMPLE ID:	AD16107-001		AD16107-002		AD16107-003		AD16107-004		AD16041-005		AD16095-017		AD16107-009	
				DATE SAMPLE COLLECTED:	3/9/2020		3/9/2020		3/9/2020		3/9/2020		3/4/2020		3/6/2020		3/9/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Carbon tetrachloride	0.76	2.4	22	44	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Chlorobenzene	1.1	100	500	1,000	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Chloroethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Chloroform	0.37	49	350	700	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Chloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
cis-1,2-Dichloroethene	0.25	100	500	1,000	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
cis-1,3-Dichloropropene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Cyclohexane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Dibromochloromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Dichlorodifluoromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Ethylbenzene	1/1	41	390	780	0.0012	U	0.001	U	0.130	U	0.190		0.0013	U	0.0011	U	0.0012	U
Isopropylbenzene	NC/2.3	NC	NC	NC	0.0012	U	0.001	U	0.130	U	0.270		0.0013	U	0.0011	U	0.0012	U
m&p-Xylenes[(1)]	NC	NC	NC	NC	0.0012	U	0.001	U	0.150		0.170		0.0013	U	0.0011	U	0.0012	U
Methyl Acetate	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Methylcyclohexane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.180		0.600		0.0025	U	0.0021	U	0.0024	U
Methylene chloride	0.05	100	500	1,000	0.0046		0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Methyl-t-butyl ether	0.93/0.93	100	500	1,000	0.0012	U	0.001	U	0.063	U	0.052	U	0.0013	U	0.0011	U	0.0012	U
n-Butylbenzene	12/12	100	500	1,000	0.0012	U	0.001	U	0.130	U	0.100	U	0.0013	U	0.0011	U	0.0012	U
n-Propylbenzene	3.9/3.9	100	500	1,000	0.0012	U	0.001	U	0.130	U	0.450		0.0013	U	0.0011	U	0.0012	U
o-Xylene[(1)]	NC	NC	NC	NC	0.0012	U	0.001	U	0.130	U	0.100	U	0.0013	U	0.0011	U	0.0012	U
sec-Butylbenzene	11/11	100	500	1,000	0.0012	U	0.001	U	0.130	U	0.760	U	0.0013	U	0.0011	U	0.0012	U
Styrene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
t-Butylbenzene	5.9/5.9	100	500	1,000	0.0012	U	0.001	U	0.130	U	0.100	U	0.0013	U	0.0011	U	0.0012	U
Tetrachloroethene	1.3	19	150	300	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Toluene	0.7/0.7	100	500	1,000	0.0012	U	0.001	U	0.130	U	0.100	U	0.0013	U	0.0011	U	0.0012	U
trans-1,2-Dichloroethene	0.19	100	500	1,000	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
trans-1,3-Dichloropropene	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Trichloroethene	0.47	21	200	400	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Trichlorofluoromethane	NC	NC	NC	NC	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Vinyl chloride	0.02	0.9	13	27	0.0023	U	0.0021	U	0.130	U	0.100	U	0.0025	U	0.0021	U	0.0024	U
Xylenes (Total)	0.26/0.26	100	500	1,000	0.0012	U	0.001	U	0.150		0.170	U	0.0013	U	0.0011	U	0.0012	U

Notes

[(1)] - There is no SCO, SSCO, or SCL for m/p-xylene or o-xylene.
The SCO/SCL for total xylenes is 0.26 mg/kg.

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:					**TRC-SB-01 (0-2)**		**TRC-SB-01 (4-6)**		**TRC-SB-02 (0-2)**		**TRC-SB-02 (4-6)**		**TRC-SB-03 (0-2)**		**TRC-SB-03 (5-7)**		**TRC-SB-04 (0-2)**	
LABORATORY SAMPLE ID:					AD16013-003		AD16013-004		AD16071-001		AD16071-002		AD16071-003		AD16071-004		AD16071-005	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
1,4-Dioxane	NC	NC	NC	NC	0.010	U	0.009	U	0.180	U	0.093	U	0.030	U	0.046	U	0.009	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2,4,5-Trichlorophenol	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2,4,6-Trichlorophenol	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2,4-Dichlorophenol	NC	NC	NC	NC	0.010	U	0.009	U	0.180	U	0.093	U	0.030	U	0.046	U	0.009	U
2,4-Dimethylphenol	NC	NC	NC	NC	0.010	U	0.009	U	0.180	U	0.093	U	0.030	U	0.046	U	0.009	U
2,4-Dinitrophenol	NC	NC	NC	NC	0.190	U	0.170	U	3.60	U	1.90	U	0.600	U	0.920	U	0.180	U
2,4-Dinitrotoluene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2,6-Dinitrotoluene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2-Chloronaphthalene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2-Chlorophenol	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2-Methylnaphthalene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.560		0.120	U	0.180	U	0.036	U
2-Methylphenol	0.33	100	500	1,000	0.010	U	0.009	U	0.180	U	0.093	U	0.030	U	0.046	U	0.009	U
2-Nitroaniline	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
2-Nitrophenol	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
3&4-Methylphenol	0.33	100	500	1,000	0.010	U	0.009	U	0.180	U	0.093	U	0.036		0.046	U	0.009	U
3,3'-Dichlorobenzidine	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
3-Nitroaniline	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	NC	0.190	U	0.170	U	3.600	U	1.900	U	0.600	U	0.920	U	0.180	U
4-Bromophenyl-phenylether	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
4-Chloro-3-methylphenol	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
4-Chloroaniline	NC	NC	NC	NC	0.010	U	0.009	U	0.180	U	0.093	U	0.030	U	0.046	U	0.009	U
4-Chlorophenyl-phenylether	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
4-Nitroaniline	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
4-Nitrophenol	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Acenaphthene	20/20	100	500	1,000	0.038	U	0.035	U	0.720	U	2.600		0.120	U	0.450		0.036	U
Acenaphthylene	100/100	100	500	1,000	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.360		0.036	U
Acetophenone	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Anthracene	100/100	100	500	1,000	0.038	U	0.035	U	1.30		4.800		0.200		2.80		0.036	U
Atrazine	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Benzaldehyde	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Benzo[a]anthracene	1/1	1	5.6	11	0.100		0.035	U	**5.00**		**11.0**		0.340		**6.80**		0.036	U
Benzo[a]pyrene	1/1	1	1	1.1	0.089		0.035	U	**7.40**		**8.70**		0.300		**5.80**		0.036	U

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:					TRC-SB-01 (0-2)		TRC-SB-01 (4-6)		TRC-SB-02 (0-2)		TRC-SB-02 (4-6)		TRC-SB-03 (0-2)		TRC-SB-03 (5-7)		TRC-SB-04 (0-2)	
LABORATORY SAMPLE ID:					AD16013-003		AD16013-004		AD16071-001		AD16071-002		AD16071-003		AD16071-004		AD16071-005	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	11	0.140		0.035	U	**9.00**		**12.0**		0.850		**7.50**		0.036	U
Benzo[g,h,i]perylene	100/100	100	500	1,000	0.058		0.035	U	7.20		3.40		0.220		3.40		0.036	U
Benzo[k]fluoranthene	0.8/0.8	3.9	56	110	0.038	U	0.035	U	**2.40**		**3.70**		0.290		**2.50**		0.036	U
bis(2-Chloroethoxy)methane	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
bis(2-Chloroethyl)ether	NC	NC	NC	NC	0.010	U	0.009	U	0.180	U	0.093	U	0.030	U	0.046	U	0.009	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Butylbenzylphthalate	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Caprolactam	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Carbazole	NC	NC	NC	NC	0.038	U	0.035	U	1.00		2.60		0.120	U	1.10		0.036	U
Chrysene	1/1	3.9	56	110	0.100		0.035	U	**5.10**		**9.20**		0.400		**6.00**		0.036	U
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	1.1	0.038	U	0.035	U	**1.40**		**1.20**		0.120	U	**0.800**		0.036	U
Dibenzofuran	7	59	350	1,000	0.010	U	0.009	U	0.290		1.50		0.032		0.620		0.009	U
Diethylphthalate	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Dimethylphthalate	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Di-n-butylphthalate	NC	NC	NC	NC	0.010		0.009	U	0.180	U	0.160		0.030	U	0.046	U	0.009	U
Di-n-octylphthalate	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Fluoranthene	100/100	100	500	1,000	0.190		0.035	U	8.90		22.0		0.490		16.0		0.036	U
Fluorene	30/30	100	500	1,000	0.038	U	0.035	U	0.720	U	2.30		0.120	U	0.370		0.036	U
Hexachlorobenzene	0.33	1.2	6	12	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Hexachlorobutadiene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Hexachlorocyclopentadiene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Hexachloroethane	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	11	0.043		0.035	U	**5.70**		**3.60**		0.210		**3.10**		0.036	U
Isophorone	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Naphthalene	12/12	100	500	1,000	0.010	U	0.009	U	0.340		1.40		0.078		0.290		0.009	U
Nitrobenzene	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
N-Nitroso-di-n-propylamine	NC	NC	NC	NC	0.010	U	0.009	U	0.180	U	0.093	U	0.030	U	0.046	U	0.009	U
N-Nitrosodiphenylamine	NC	NC	NC	NC	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Pentachlorophenol	0.8	6.7	6.7	55	0.190	U	0.170	U	3.60	U	1.90	U	0.600	U	0.920	U	0.180	U
Phenanthrene	100/100	100	500	1,000	0.092		0.035	U	5.00		21.0		0.280		13.0		0.036	U
Phenol	0.33	100	500	1,000	0.038	U	0.035	U	0.720	U	0.370	U	0.120	U	0.180	U	0.036	U
Pyrene	100/100	100	500	1,000	0.180		0.035	U	8.70		19.0		0.550		14.0		0.036	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	**TRC-SB-04 (5-7)**		**TRC-SB-05 (0-2)**		**TRC-SB-05 (5-7)**		**TRC-SB-06 (0-2)**		**TRC-SB-06 (6-8)**		**TRC-SB-07 (0-2)**		**TRC-SB-07 (4-6)**	
				LABORATORY SAMPLE ID:	AD16071-006		AD16041-010		AD16041-011		AD16095-007		AD16095-008		AD16095-003		AD16095-004	
				DATE SAMPLE COLLECTED:	3/5/2020		3/4/2020		3/4/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
1,4-Dioxane	NC	NC	NC	NC	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2,4,5-Trichlorophenol	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2,4,6-Trichlorophenol	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2,4-Dichlorophenol	NC	NC	NC	NC	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
2,4-Dimethylphenol	NC	NC	NC	NC	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
2,4-Dinitrophenol	NC	NC	NC	NC	0.180	U	0.180	U	0.190	U	0.350	U	0.180	U	0.180	U	0.180	U
2,4-Dinitrotoluene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2,6-Dinitrotoluene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2-Chloronaphthalene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2-Chlorophenol	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2-Methylnaphthalene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2-Methylphenol	0.33	100	500	1,000	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
2-Nitroaniline	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
2-Nitrophenol	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
3&4-Methylphenol	0.33	100	500	1,000	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
3,3'-Dichlorobenzidine	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
3-Nitroaniline	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	NC	0.180	U	0.180	U	0.190	U	0.350	U	0.180	U	0.180	U	0.180	U
4-Bromophenyl-phenylether	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
4-Chloro-3-methylphenol	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
4-Chloroaniline	NC	NC	NC	NC	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
4-Chlorophenyl-phenylether	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
4-Nitroaniline	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
4-Nitrophenol	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Acenaphthene	20/20	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Acenaphthylene	100/100	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Acetophenone	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Anthracene	100/100	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Atrazine	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Benzaldehyde	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Benzo[a]anthracene	1/1	1	5.6	11	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Benzo[a]pyrene	1/1	1	1	1.1	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	**TRC-SB-04 (5-7)**		**TRC-SB-05 (0-2)**		**TRC-SB-05 (5-7)**		**TRC-SB-06 (0-2)**		**TRC-SB-06 (6-8)**		**TRC-SB-07 (0-2)**		**TRC-SB-07 (4-6)**	
				LABORATORY SAMPLE ID:	AD16071-006		AD16041-010		AD16041-011		AD16095-007		AD16095-008		AD16095-003		AD16095-004	
				DATE SAMPLE COLLECTED:	3/5/2020		3/4/2020		3/4/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	11	0.036	U	0.035	U	0.037	U	0.095		0.035	U	0.035	U	0.035	U
Benzo[g,h,i]perylene	100/100	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Benzo[k]fluoranthene	0.8/0.8	3.9	56	110	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
bis(2-Chloroethoxy)methane	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
bis(2-Chloroethyl)ether	NC	NC	NC	NC	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Butylbenzylphthalate	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Caprolactam	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Carbazole	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Chrysene	1/1	3.9	56	110	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	1.1	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Dibenzofuran	7	59	350	1,000	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
Diethylphthalate	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Dimethylphthalate	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Di-n-butylphthalate	NC	NC	NC	NC	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
Di-n-octylphthalate	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Fluoranthene	100/100	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.038		0.035	U	0.035	U
Fluorene	30/30	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Hexachlorobenzene	0.33	1.2	6	12	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Hexachlorobutadiene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Hexachlorocyclopentadiene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Hexachloroethane	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	11	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Isophorone	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Naphthalene	12/12	100	500	1,000	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
Nitrobenzene	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
N-Nitroso-di-n-propylamine	NC	NC	NC	NC	0.009	U	0.009	U	0.009	U	0.018	U	0.009	U	0.009	U	0.009	U
N-Nitrosodiphenylamine	NC	NC	NC	NC	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Pentachlorophenol	0.8	6.7	6.7	55	0.180	U	0.180	U	0.190	U	0.350	U	0.180	U	0.180	U	0.180	U
Phenanthrene	100/100	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Phenol	0.33	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.035	U	0.035	U	0.035	U
Pyrene	100/100	100	500	1,000	0.036	U	0.035	U	0.037	U	0.070	U	0.036		0.035	U	0.035	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:					TRC-SB-08 (0-2)		TRC-SB-08 (6-8)		TRC-SB-09 (0-2)		TRC-SB-09 (4-6)		TRC-SB-10 (0-2)		TRC-SB-10 (4-6)		TRC-SB-11 (0-2)	
LABORATORY SAMPLE ID:					AD16013-005		AD16013-006		AD16013-001		AD16013-002		AD16041-008		AD16041-009		AD16071-007	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/5/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
1,4-Dioxane	NC	NC	NC	NC	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2,4,5-Trichlorophenol	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2,4,6-Trichlorophenol	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2,4-Dichlorophenol	NC	NC	NC	NC	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
2,4-Dimethylphenol	NC	NC	NC	NC	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
2,4-Dinitrophenol	NC	NC	NC	NC	0.540	U	1.80	U	10.000	U	0.190	U	1.80	U	0.180	U	0.920	U
2,4-Dinitrotoluene	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2,6-Dinitrotoluene	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2-Chloronaphthalene	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2-Chlorophenol	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2-Methylnaphthalene	NC	NC	NC	NC	0.110	U	0.360	U	2.50		0.039	U	0.360	U	0.035	U	0.180	U
2-Methylphenol	0.33	100	500	1,000	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
2-Nitroaniline	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
2-Nitrophenol	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
3&4-Methylphenol	0.33	100	500	1,000	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
3,3'-Dichlorobenzidine	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
3-Nitroaniline	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	NC	0.540	U	1.80	U	10.000	U	0.190	U	1.80	U	0.180	U	0.920	U
4-Bromophenyl-phenylether	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
4-Chloro-3-methylphenol	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
4-Chloroaniline	NC	NC	NC	NC	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
4-Chlorophenyl-phenylether	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
4-Nitroaniline	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
4-Nitrophenol	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Acenaphthene	20/20	100	500	1,000	0.110	U	0.360	U	7.00		0.039	U	0.360	U	0.035	U	0.640	
Acenaphthylene	100/100	100	500	1,000	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Acetophenone	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Anthracene	100/100	100	500	1,000	0.130		0.400		15.0		0.039	U	0.360	U	0.035	U	1.20	
Atrazine	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Benzaldehyde	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Benzo[a]anthracene	1/1	1	5.6	11	0.410		**1.40**		**44.0**		0.039	U	**1.30**		0.035	U	**4.50**	
Benzo[a]pyrene	1/1	1	1	1.1	0.430		**1.10**		**43.0**		0.039	U	**1.20**		0.035	U	**4.10**	

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:					TRC-SB-08 (0-2)		TRC-SB-08 (6-8)		TRC-SB-09 (0-2)		TRC-SB-09 (4-6)		TRC-SB-10 (0-2)		TRC-SB-10 (4-6)		TRC-SB-11 (0-2)	
LABORATORY SAMPLE ID:					AD16013-005		AD16013-006		AD16013-001		AD16013-002		AD16041-008		AD16041-009		AD16071-007	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/5/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	11	0.620		**1.30**		**51.0**		0.039	U	**1.90**		0.035	U	**5.30**	
Benzo[g,h,i]perylene	100/100	100	500	1,000	0.280		0.670		24.0		0.039	U	0.740		0.035	U	2.40	
Benzo[k]fluoranthene	0.8/0.8	3.9	56	110	0.180		0.400		**15.0**		0.039	U	0.450		0.035	U	**1.70**	
bis(2-Chloroethoxy)methane	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
bis(2-Chloroethyl)ether	NC	NC	NC	NC	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.410		0.035	U	0.320	
Butylbenzylphthalate	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Caprolactam	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Carbazole	NC	NC	NC	NC	0.110	U	0.360	U	6.40		0.039	U	0.360	U	0.035	U	0.740	
Chrysene	1/1	3.9	56	110	0.410		**1.30**		**42.0**		0.039	U	**1.40**		0.035	U	**4.20**	
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	1.1	0.110	U	0.360	U	**6.10**		0.039	U	0.360	U	0.035	U	**0.630**	
Dibenzofuran	7	59	350	1,000	0.028		0.091	U	5.00		0.010	U	0.091	U	0.009	U	0.330	
Diethylphthalate	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Dimethylphthalate	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Di-n-butylphthalate	NC	NC	NC	NC	0.027	U	0.091	U	0.510	U	0.010	U	0.840		0.009	U	0.046	U
Di-n-octylphthalate	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Fluoranthene	100/100	100	500	1,000	0.580		2.30		93.0		0.039	U	2.40		0.035	U	8.90	
Fluorene	30/30	100	500	1,000	0.110	U	0.360	U	6.50		0.039	U	0.360	U	0.035	U	0.530	
Hexachlorobenzene	0.33	1.2	6	12	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Hexachlorobutadiene	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Hexachlorocyclopentadiene	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Hexachloroethane	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	2.30	
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	11	0.250		**0.530**		**21.0**		0.039	U	**0.680**		0.035	U	0.180	U
Isophorone	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.240	
Naphthalene	12/12	100	500	1,000	0.027	U	0.091	U	4.70		0.010	U	0.091	U	0.009	U	0.046	U
Nitrobenzene	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
N-Nitroso-di-n-propylamine	NC	NC	NC	NC	0.027	U	0.091	U	0.510	U	0.010	U	0.091	U	0.009	U	0.046	U
N-Nitrosodiphenylamine	NC	NC	NC	NC	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Pentachlorophenol	0.8	6.7	6.7	55	0.540	U	1.80	U	10.0	U	0.190	U	1.80	U	0.180	U	0.920	U
Phenanthrene	100/100	100	500	1,000	0.430		2.40		84.0		0.039	U	1.60		0.035	U	6.30	
Phenol	0.33	100	500	1,000	0.110	U	0.360	U	2.10	U	0.039	U	0.360	U	0.035	U	0.180	U
Pyrene	100/100	100	500	1,000	0.580		2.80		94.0		0.042		2.40		0.035	U	8.10	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	TRC-SB-11 (4-6)		TRC-SB-12 (0-2)		TRC-SB-12 (3-5)		TRC-SB-13 (0-2)		TRC-SB-13 (6-8)		TRC-SB-14 (0-2)		TRC-SB-14 (4-6)	
				LABORATORY SAMPLE ID:	AD16071-008		AD16041-003		AD16041-004		AD16071-009		AD16071-010		AD16095-001		AD16095-002	
				DATE SAMPLE COLLECTED:	3/5/2020		3/4/2020		3/4/2020		3/5/2020		3/5/2020		3/6/2020		3/6/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
1,4-Dioxane	NC	NC	NC	NC	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2,4,5-Trichlorophenol	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2,4,6-Trichlorophenol	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2,4-Dichlorophenol	NC	NC	NC	NC	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
2,4-Dimethylphenol	NC	NC	NC	NC	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
2,4-Dinitrophenol	NC	NC	NC	NC	0.190	U	1.90	U	0.190	U	0.180	U	0.180	U	1.80	U	0.940	U
2,4-Dinitrotoluene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2,6-Dinitrotoluene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2-Chloronaphthalene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2-Chlorophenol	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2-Methylnaphthalene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2-Methylphenol	0.33	100	500	1,000	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
2-Nitroaniline	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
2-Nitrophenol	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
3&4-Methylphenol	0.33	100	500	1,000	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
3,3'-Dichlorobenzidine	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
3-Nitroaniline	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	NC	0.190	U	1.90	U	0.190	U	0.180	U	0.180	U	1.800	U	0.940	U
4-Bromophenyl-phenylether	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
4-Chloro-3-methylphenol	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
4-Chloroaniline	NC	NC	NC	NC	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
4-Chlorophenyl-phenylether	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
4-Nitroaniline	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
4-Nitrophenol	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Acenaphthene	20/20	100	500	1,000	0.064		1.20		0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Acenaphthylene	100/100	100	500	1,000	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Acetophenone	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Anthracene	100/100	100	500	1,000	0.170		2.70		0.038	U	0.044		0.035	U	0.360	U	0.390	
Atrazine	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Benzaldehyde	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Benzo[a]anthracene	1/1	1	5.6	11	0.640		**8.60**		0.038	U	0.790		0.220		0.360	U	**1.40**	
Benzo[a]pyrene	1/1	1	1	1.1	0.590		**8.30**		0.038	U	0.830		0.240		0.360	U	**1.30**	

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	**TRC-SB-11 (4-6)**		**TRC-SB-12 (0-2)**		**TRC-SB-12 (3-5)**		**TRC-SB-13 (0-2)**		**TRC-SB-13 (6-8)**		**TRC-SB-14 (0-2)**		**TRC-SB-14 (4-6)**	
				LABORATORY SAMPLE ID:	AD16071-008		AD16041-003		AD16041-004		AD16071-009		AD16071-010		AD16095-001		AD16095-002	
				DATE SAMPLE COLLECTED:	3/5/2020		3/4/2020		3/4/2020		3/5/2020		3/5/2020		3/6/2020		3/6/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	11	0.770		**10.0**		0.038	U	1.00		0.300		0.360	U	**1.80**	
Benzo[g,h,i]perylene	100/100	100	500	1,000	0.400		4.30		0.038	U	0.480		0.140		0.360	U	0.590	
Benzo[k]fluoranthene	0.8/0.8	3.9	56	110	0.270		**3.10**		0.038	U	0.350		0.089		0.360	U	0.660	
bis(2-Chloroethoxy)methane	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
bis(2-Chloroethyl)ether	NC	NC	NC	NC	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Butylbenzylphthalate	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Caprolactam	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Carbazole	NC	NC	NC	NC	0.087		0.920		0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Chrysene	1/1	3.9	56	110	0.600		**8.40**		0.038	U	0.590		0.170		0.360	U	**1.10**	
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	1.1	0.110		**1.10**		0.038	U	0.130		0.035	U	0.360	U	0.190	
Dibenzofuran	7	59	350	1,000	0.038		0.620		0.010	U	0.009	U	0.009	U	0.090	U	0.100	
Diethylphthalate	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Dimethylphthalate	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Di-n-butylphthalate	NC	NC	NC	NC	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
Di-n-octylphthalate	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Fluoranthene	100/100	100	500	1,000	1.20		16.0		0.038	U	0.820		0.260		0.360	U	2.20	
Fluorene	30/30	100	500	1,000	0.057		1.10		0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Hexachlorobenzene	0.33	1.2	6	12	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Hexachlorobutadiene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Hexachlorocyclopentadiene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Hexachloroethane	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	11	0.360		**4.10**		0.038	U	0.450		0.130		0.360	U	**0.530**	
Isophorone	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Naphthalene	12/12	100	500	1,000	0.025		0.400		0.010	U	0.009	U	0.009	U	0.090	U	0.048	
Nitrobenzene	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
N-Nitroso-di-n-propylamine	NC	NC	NC	NC	0.010	U	0.094	U	0.010	U	0.009	U	0.009	U	0.090	U	0.047	U
N-Nitrosodiphenylamine	NC	NC	NC	NC	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Pentachlorophenol	0.8	6.7	6.7	55	0.190	U	1.900	U	0.190	U	0.180	U	0.180	U	1.80	U	0.940	U
Phenanthrene	100/100	100	500	1,000	0.860		13.0		0.038	U	0.110		0.035	U	0.360	U	1.20	
Phenol	0.33	100	500	1,000	0.038	U	0.370	U	0.038	U	0.036	U	0.035	U	0.360	U	0.190	U
Pyrene	100/100	100	500	1,000	1.10		17.0		0.038	U	0.920		0.290		0.360	U	2.10	

Notes
TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective
Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:					TRC-SB-15 (0-2)		TRC-SB-15 (9-11)		TRC-SB-16 (0-2)		TRC-SB-16 (8-10)		TRC-SB-17 (0-2)		TRC-SB-17 (15-17)		TRC-SB-18 (0-2)	
LABORATORY SAMPLE ID:					AD16095-005		AD16095-006		AD16107-005		AD16107-006		AD16013-007		AD16013-008		AD16041-001	
DATE SAMPLE COLLECTED:					3/6/2020		3/6/2020		3/9/2020		3/9/2020		3/3/2020		3/3/2020		3/4/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
1,4-Dioxane	NC	NC	NC	NC	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2,4,5-Trichlorophenol	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2,4,6-Trichlorophenol	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2,4-Dichlorophenol	NC	NC	NC	NC	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
2,4-Dimethylphenol	NC	NC	NC	NC	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
2,4-Dinitrophenol	NC	NC	NC	NC	0.180	U	0.180	U	0.19	U	0.190	U	0.180	U	0.180	U	2.600	U
2,4-Dinitrotoluene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2,6-Dinitrotoluene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2-Chloronaphthalene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2-Chlorophenol	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2-Methylnaphthalene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2-Methylphenol	0.33	100	500	1,000	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
2-Nitroaniline	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
2-Nitrophenol	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
3&4-Methylphenol	0.33	100	500	1,000	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
3,3'-Dichlorobenzidine	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
3-Nitroaniline	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	NC	0.180	U	0.180	U	0.19	U	0.19	U	0.180	U	0.180	U	2.60	U
4-Bromophenyl-phenylether	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
4-Chloro-3-methylphenol	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
4-Chloroaniline	NC	NC	NC	NC	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
4-Chlorophenyl-phenylether	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
4-Nitroaniline	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
4-Nitrophenol	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Acenaphthene	20/20	100	500	1,000	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Acenaphthylene	100/100	100	500	1,000	0.035	U	0.037	U	0.037		0.039	U	0.036	U	0.035	U	0.520	U
Acetophenone	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Anthracene	100/100	100	500	1,000	0.035	U	0.037	U	0.059		0.039	U	0.050		0.060		0.520	U
Atrazine	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Benzaldehyde	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Benzo[a]anthracene	1/1	1	5.6	11	0.035	U	0.037	U	0.320		0.039	U	0.063		0.084		0.520	U
Benzo[a]pyrene	1/1	1	1	1.1	0.035	U	0.037	U	0.350		0.039	U	0.042		0.065		0.520	U

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New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	TRC-SB-15 (0-2)		TRC-SB-15 (9-11)		TRC-SB-16 (0-2)		TRC-SB-16 (8-10)		TRC-SB-17 (0-2)		TRC-SB-17 (15-17)		TRC-SB-18 (0-2)	
				LABORATORY SAMPLE ID:	AD16095-005		AD16095-006		AD16107-005		AD16107-006		AD16013-007		AD16013-008		AD16041-001	
				DATE SAMPLE COLLECTED:	3/6/2020		3/6/2020		3/9/2020		3/9/2020		3/3/2020		3/3/2020		3/4/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	11	0.035	U	0.037	U	0.510		0.039	U	0.044		0.069		0.520	U
Benzo[g,h,i]perylene	100/100	100	500	1,000	0.035	U	0.037	U	0.200		0.039	U	0.036	U	0.035	U	0.520	U
Benzo[k]fluoranthene	0.8/0.8	3.9	56	110	0.035	U	0.037	U	0.140		0.039	U	0.036	U	0.035	U	0.520	U
bis(2-Chloroethoxy)methane	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
bis(2-Chloroethyl)ether	NC	NC	NC	NC	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Butylbenzylphthalate	NC	NC	NC	NC	0.035	U	0.037	U	1.00		0.039	U	0.036	U	0.035	U	0.520	U
Caprolactam	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Carbazole	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Chrysene	1/1	3.9	56	110	0.035	U	0.037	U	0.340		0.039	U	0.050		0.065		0.520	U
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	1.1	0.035	U	0.037	U	0.050		0.039	U	0.036	U	0.035	U	0.520	U
Dibenzofuran	7	59	350	1,000	0.009	U	0.009	U	0.0093	U	0.0097	U	0.020		0.025		0.130	U
Diethylphthalate	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Dimethylphthalate	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Di-n-butylphthalate	NC	NC	NC	NC	0.045		0.009	U	0.026		0.018		0.009	U	0.026		0.130	U
Di-n-octylphthalate	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Fluoranthene	100/100	100	500	1,000	0.035	U	0.037	U	0.510		0.039	U	0.110		0.140		0.520	U
Fluorene	30/30	100	500	1,000	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Hexachlorobenzene	0.33	1.2	6	12	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Hexachlorobutadiene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Hexachlorocyclopentadiene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Hexachloroethane	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	11	0.035	U	0.037	U	0.180		0.039	U	0.036	U	0.035	U	0.520	U
Isophorone	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Naphthalene	12/12	100	500	1,000	0.009	U	0.009	U	0.014		0.0097	U	0.015		0.015		0.130	U
Nitrobenzene	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
N-Nitroso-di-n-propylamine	NC	NC	NC	NC	0.009	U	0.009	U	0.0093	U	0.0097	U	0.009	U	0.0089	U	0.130	U
N-Nitrosodiphenylamine	NC	NC	NC	NC	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Pentachlorophenol	0.8	6.7	6.7	55	0.180	U	0.180	U	0.190	U	0.190	U	0.180	U	0.180	U	2.60	U
Phenanthrene	100/100	100	500	1,000	0.035	U	0.037	U	0.200		0.039	U	0.150		0.180		0.520	U
Phenol	0.33	100	500	1,000	0.035	U	0.037	U	0.037	U	0.039	U	0.036	U	0.035	U	0.520	U
Pyrene	100/100	100	500	1,000	0.035	U	0.037	U	0.500		0.039	U	0.096		0.130		0.520	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	**TRC-SB-18 (5-7)**		**TRC-SB-19 (0-2)**		**TRC-SB-19 (7-9)**		**TRC-SB-20 (0-2)**		**TRC-SB-20 (6-8)**		**TRC-SB-21 (0-2)**		**TRC-SB-21 (6-8)**	
				LABORATORY SAMPLE ID:	AD16041-002		AD16041-006		AD16041-007		AD16107-007		AD16107-008		AD16107-001		AD16107-002	
				DATE SAMPLE COLLECTED:	3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/9/2020		3/9/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	NC	0.035	U	8.60		0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
1,4-Dioxane	NC	NC	NC	NC	0.0088	U	0.54	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2,4,5-Trichlorophenol	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2,4,6-Trichlorophenol	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2,4-Dichlorophenol	NC	NC	NC	NC	0.0088	U	0.54	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
2,4-Dimethylphenol	NC	NC	NC	NC	0.0088	U	0.54	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
2,4-Dinitrophenol	NC	NC	NC	NC	0.180	U	11.00	U	0.190	U	1.90	U	0.180	U	0.900	U	0.180	U
2,4-Dinitrotoluene	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2,6-Dinitrotoluene	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2-Chloronaphthalene	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2-Chlorophenol	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2-Methylnaphthalene	NC	NC	NC	NC	0.035	U	34.0		0.038	U	0.370	U	0.037	U	0.180	U	0.068	
2-Methylphenol	0.33	100	500	1,000	0.0088	U	0.54	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
2-Nitroaniline	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
2-Nitrophenol	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
3&4-Methylphenol	0.33	100	500	1,000	0.0088	U	0.540	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
3,3'-Dichlorobenzidine	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
3-Nitroaniline	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	NC	0.18	U	11.0	U	0.190	U	1.90	U	0.180	U	0.900	U	0.180	U
4-Bromophenyl-phenylether	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
4-Chloro-3-methylphenol	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
4-Chloroaniline	NC	NC	NC	NC	0.0088	U	0.54	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
4-Chlorophenyl-phenylether	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
4-Nitroaniline	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
4-Nitrophenol	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Acenaphthene	20/20	100	500	1,000	0.035	U	**53.0**		0.038	U	0.370	U	0.037	U	0.380		0.093	
Acenaphthylene	100/100	100	500	1,000	0.035	U	2.20	U	0.038	U	0.410		0.037	U	0.180	U	0.037	U
Acetophenone	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Anthracene	100/100	100	500	1,000	0.035	U	48.0		0.038	U	0.770		0.037	U	0.810		0.160	
Atrazine	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Benzaldehyde	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Benzo[a]anthracene	1/1	1	5.6	11	0.035	U	**15.0**		0.038	U	**2.10**		0.037	U	**1.60**		0.290	
Benzo[a]pyrene	1/1	1	1	1.1	0.035	U	**7.90**		0.038	U	**2.10**		0.037	U	**1.20**		0.210	

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	TRC-SB-18 (5-7)		TRC-SB-19 (0-2)		TRC-SB-19 (7-9)		TRC-SB-20 (0-2)		TRC-SB-20 (6-8)		TRC-SB-21 (0-2)		TRC-SB-21 (6-8)	
				LABORATORY SAMPLE ID:	AD16041-002		AD16041-006		AD16041-007		AD16107-007		AD16107-008		AD16107-001		AD16107-002	
				DATE SAMPLE COLLECTED:	3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/9/2020		3/9/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	11	0.035	U	**11.0**		0.038	U	**3.60**		0.037	U	**1.60**		0.350	
Benzo[g,h,i]perylene	100/100	100	500	1,000	0.035	U	3.80		0.038	U	1.10		0.037	U	0.440		0.100	
Benzo[k]fluoranthene	0.8/0.8	3.9	56	110	0.035	U	**4.20**		0.038	U	**0.960**		0.037	U	0.640		0.092	
bis(2-Chloroethoxy)methane	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
bis(2-Chloroethyl)ether	NC	NC	NC	NC	0.0088	U	0.54	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	NC	0.035	U	11.0		0.038	U	0.380		0.037	U	0.210		0.057	
Butylbenzylphthalate	NC	NC	NC	NC	0.035	U	8.90		0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Caprolactam	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Carbazole	NC	NC	NC	NC	0.035	U	13.0		0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Chrysene	1/1	3.9	56	110	0.035	U	**13.0**		0.038	U	**2.30**		0.037	U	**1.50**		0.320	
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	1.1	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Dibenzofuran	7	59	350	1,000	0.0088	U	**37.0**		0.010	U	0.240		0.009	U	0.240		0.082	
Diethylphthalate	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Dimethylphthalate	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Di-n-butylphthalate	NC	NC	NC	NC	0.0088	U	0.54	U	0.010	U	0.093	U	0.011		0.045	U	0.011	
Di-n-octylphthalate	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Fluoranthene	100/100	100	500	1,000	0.035	U	71.0		0.038	U	3.60		0.037	U	3.60		0.730	
Fluorene	30/30	100	500	1,000	0.035	U	**58.0**		0.038	U	0.370	U	0.037	U	0.180	U	0.074	
Hexachlorobenzene	0.33	1.2	6	12	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Hexachlorobutadiene	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Hexachlorocyclopentadiene	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Hexachloroethane	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	11	0.035	U	**3.50**		0.038	U	**1.10**		0.037	U	0.460		0.089	
Isophorone	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Naphthalene	12/12	100	500	1,000	0.0088	U	**54.0**		0.010	U	0.210		0.009	U	0.049		0.075	
Nitrobenzene	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
N-Nitroso-di-n-propylamine	NC	NC	NC	NC	0.0088	U	0.54	U	0.010	U	0.093	U	0.009	U	0.045	U	0.0092	U
N-Nitrosodiphenylamine	NC	NC	NC	NC	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Pentachlorophenol	0.8	6.7	6.7	55	0.180	U	11.0	U	0.190	U	1.90	U	0.180	U	0.900	U	0.180	U
Phenanthrene	100/100	100	500	1,000	0.035	U	**170**		0.038	U	2.10		0.037	U	2.00		0.510	
Phenol	0.33	100	500	1,000	0.035	U	2.20	U	0.038	U	0.370	U	0.037	U	0.180	U	0.037	U
Pyrene	100/100	100	500	1,000	0.035	U	53.0		0.038	U	3.30		0.037	U	3.10		0.680	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective
Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

				SAMPLE ID:	**TRC-SB-22 (0-2)**		**TRC-SB-22 (6-8)**		**TRC-DUP-01**		**TRC-DUP-02**		**TRC-DUP-03**	
				LABORATORY SAMPLE ID:	AD16107-003		AD16107-004		AD16041-005		AD16095-017		AD16107-009	
				DATE SAMPLE COLLECTED:	3/9/2020		3/9/2020		3/4/2020		3/6/2020		3/9/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	NC	0.190	U	0.630		0.036	U	0.035	U	0.190	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
1,4-Dioxane	NC	NC	NC	NC	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2,4,5-Trichlorophenol	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2,4,6-Trichlorophenol	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2,4-Dichlorophenol	NC	NC	NC	NC	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
2,4-Dimethylphenol	NC	NC	NC	NC	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
2,4-Dinitrophenol	NC	NC	NC	NC	0.950	U	0.380	U	0.180	U	0.180	U	0.950	U
2,4-Dinitrotoluene	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2,6-Dinitrotoluene	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2-Chloronaphthalene	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2-Chlorophenol	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2-Methylnaphthalene	NC	NC	NC	NC	0.520		4.10		0.036	U	0.035	U	0.290	
2-Methylphenol	0.33	100	500	1,000	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
2-Nitroaniline	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
2-Nitrophenol	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
3&4-Methylphenol	0.33	100	500	1,000	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
3,3'-Dichlorobenzidine	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
3-Nitroaniline	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	NC	0.950	U	0.380	U	0.180	U	0.180	U	0.950	U
4-Bromophenyl-phenylether	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
4-Chloro-3-methylphenol	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
4-Chloroaniline	NC	NC	NC	NC	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
4-Chlorophenyl-phenylether	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
4-Nitroaniline	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
4-Nitrophenol	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Acenaphthene	20/20	100	500	1,000	0.270		0.076	U	0.036	U	0.035	U	0.280	
Acenaphthylene	100/100	100	500	1,000	0.190	U	0.076	U	0.036	U	0.035	U	0.680	
Acetophenone	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Anthracene	100/100	100	500	1,000	0.190	U	0.076	U	0.036	U	0.035	U	1.10	
Atrazine	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Benzaldehyde	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Benzo[a]anthracene	1/1	1	5.6	11	0.190	U	0.270		0.036	U	0.035	U	**2.80**	
Benzo[a]pyrene	1/1	1	1	1.1	0.190	U	0.260		0.036	U	0.035	U	**3.10**	

Table 2
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:					**TRC-SB-22 (0-2)**		**TRC-SB-22 (6-8)**		**TRC-DUP-01**		**TRC-DUP-02**		**TRC-DUP-03**	
LABORATORY SAMPLE ID:					AD16107-003		AD16107-004		AD16041-005		AD16095-017		AD16107-009	
DATE SAMPLE COLLECTED:					3/9/2020		3/9/2020		3/4/2020		3/6/2020		3/9/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	11	0.220		0.380		0.036	U	0.035	U	**6.10**	
Benzo[g,h,i]perylene	100/100	100	500	1,000	0.190	U	0.150		0.036	U	0.035	U	1.60	
Benzo[k]fluoranthene	0.8/0.8	3.9	56	110	0.190	U	0.100		0.036	U	0.035	U	**1.70**	
bis(2-Chloroethoxy)methane	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
bis(2-Chloroethyl)ether	NC	NC	NC	NC	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	3.30	
Butylbenzylphthalate	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Caprolactam	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Carbazole	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.560	
Chrysene	1/1	3.9	56	110	0.190	U	0.290		0.036	U	0.035	U	**3.20**	
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	1.1	0.190	U	0.076	U	0.036	U	0.035	U	**0.550**	
Dibenzofuran	7	59	350	1,000	0.200		0.420		0.009	U	0.009	U	0.410	
Diethylphthalate	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Dimethylphthalate	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Di-n-butylphthalate	NC	NC	NC	NC	0.047	U	0.019	U	0.013		0.009	U	0.059	
Di-n-octylphthalate	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Fluoranthene	100/100	100	500	1,000	0.230		0.580		0.036	U	0.035	U	4.90	
Fluorene	30/30	100	500	1,000	0.470		0.076	U	0.036	U	0.035	U	0.280	
Hexachlorobenzene	0.33	1.2	6	12	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Hexachlorobutadiene	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Hexachlorocyclopentadiene	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Hexachloroethane	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	11	0.190	U	0.120		0.036	U	0.035	U	**1.80**	
Isophorone	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Naphthalene	12/12	100	500	1,000	0.310		1.00		0.009	U	0.009	U	0.330	
Nitrobenzene	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
N-Nitroso-di-n-propylamine	NC	NC	NC	NC	0.047	U	0.019	U	0.009	U	0.009	U	0.047	U
N-Nitrosodiphenylamine	NC	NC	NC	NC	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Pentachlorophenol	0.8	6.7	6.7	55	0.950	U	0.380	U	0.180	U	0.180	U	0.950	U
Phenanthrene	100/100	100	500	1,000	0.950		1.80		0.036	U	0.035	U	2.70	
Phenol	0.33	100	500	1,000	0.190	U	0.076	U	0.036	U	0.035	U	0.190	U
Pyrene	100/100	100	500	1,000	0.270		0.570		0.036	U	0.035	U	4.20	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 3
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

				SAMPLE ID:	TRC-SB-01 (0-2)		TRC-SB-01 (4-6)		TRC-SB-02 (0-2)		TRC-SB-02 (4-6)		TRC-SB-03 (0-2)		TRC-SB-03 (5-7)	
				LABORATORY SAMPLE ID:	AD16013-003		AD16013-004		AD16071-001		AD16071-002		AD16071-003		AD16071-004	
				DATE SAMPLE COLLECTED:	3/3/2020		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	5,300		2,100		5,000		3,400		5,500		5,400	
Antimony	NC	NC	NC	NC	0.92	U	0.83	U	0.87	U	1.20		0.95	U	0.88	U
Arsenic	13	16	16	16	5.80		1.60		5.50		13.0		6.40		3.00	
Barium	350	400	400	10,000	49.0		71.0		170		220		90.0		92.0	
Beryllium	7.2	72	590	2,700	0.24		0.21	U	**8.60**		0.31		0.38		0.36	
Cadmium	2.5	4.3	9.3	60	0.46	U	0.42	U	0.75		1.10		0.48	U	0.44	U
Calcium	NC	NC	NC	NC	29,000		1,000	U	7,400		22,000		17,000		4,400	
Chromium	30	180	1,500	6,800	9.50		5.90		25.0		23.0		16.0		11.0	
Cobalt	NC	NC	NC	NC	4.70		2.60	U	26.0		5.50		7.80		4.9	
Copper	50	270	270	10,000	27.0		14.0		**360**		**58.0**		50.0		14.0	
Iron	NC	NC	NC	NC	9,900		8,000		28,000		15,000		12,000		12,000	
Lead	63	400	1,000	3,900	**68.0**		**68.0**		**650**		**360**		**84.0**		61.0	
Magnesium	NC	NC	NC	NC	2,400		1,100		2,100		4,600		5,900		1,700	
Manganese	1,600	2,000	10,000	10,000	130		81.0		410		210		310		220	
Mercury	0.18	0.81	2.8	5.7	0.096	U	0.12		**1.10**		**0.920**		0.18		0.16	
Nickel	30	310	310	10,000	16.0		7.70		**170**		20.0		**51.0**		11.0	
Potassium	NC	NC	NC	NC	750		520	U	550		560	U	1,100		630	
Selenium	3.9	180	1,500	6,800	2.30	U	2.10	U	2.20	U	2.20	U	2.40	U	2.20	U
Silver	2	180	1,500	6,800	0.23	U	0.21	U	0.42		0.22	U	0.24	U	0.22	U
Sodium	NC	NC	NC	NC	290	U	260	U	390		280	U	400		270	U
Thallium	NC	NC	NC	NC	0.46	U	0.42	U	0.43	U	0.44	U	0.48	U	0.44	U
Vanadium	NC	NC	NC	NC	14.0		11.0		31.0		22.0		19.0		15.0	
Zinc	109	10,000	10,000	10,000	**110**		**150**		**2,000**		**380**		**310**		64.0	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.
U - Non-detect
J - Estimated value

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Table 3
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

				SAMPLE ID:	TRC-SB-04 (0-2)		TRC-SB-04 (5-7)		TRC-SB-05 (0-2)		TRC-SB-05 (5-7)		TRC-SB-06 (0-2)		TRC-SB-06 (6-8)	
				LABORATORY SAMPLE ID:	AD16071-005		AD16071-006		AD16041-010		AD16041-011		AD16095-007		AD16095-008	
				DATE SAMPLE COLLECTED:	3/5/2020		3/5/2020		3/4/2020		3/4/2020		3/6/2020		3/6/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	5,200		6,000		4,900		3,400		2,200		2,500	
Antimony	NC	NC	NC	NC	0.87	U	0.87	U	0.85	U	0.89	U	0.84	U	0.84	U
Arsenic	13	16	16	16	0.91		0.93		1.00		0.61		0.67		1.40	
Barium	350	400	400	10,000	44.0		73.0		35.0		89.0		18.0		21.0	
Beryllium	7.2	72	590	2,700	0.22	U	0.22	U	0.21	U	0.22	U	0.21	U	0.21	U
Cadmium	2.5	4.3	9.3	60	0.43	U	0.43	U	0.43	U	0.44	U	0.42	U	0.42	U
Calcium	NC	NC	NC	NC	1,100	U	12,000		2,200		1,500		1,100	U	5,000	
Chromium	30	180	1,500	6,800	10.0		13.0		11.0		11.0		7.00		5.60	
Cobalt	NC	NC	NC	NC	6.10		5.60		5.40		3.70		3.30		3.10	
Copper	50	270	270	10,000	9.80		6.70		10.0		6.80		30.0		6.90	
Iron	NC	NC	NC	NC	11,000		10,000		10,000		8,900		7,700		6,000	
Lead	63	400	1,000	3,900	5.40	U	5.40	U	5.30	U	5.60	U	**65.0**		5.30	U
Magnesium	NC	NC	NC	NC	2,000		3,400		2,400		1,500		1,600		2,600	
Manganese	1,600	2,000	10,000	10,000	350		240		310		220		140		220	
Mercury	0.18	0.81	2.8	5.7	0.091	U	0.091	U	0.089	U	0.093	U	0.088	U	0.088	U
Nickel	30	310	310	10,000	22.0		15.0		18.0		11.0		11.0		7.60	
Potassium	NC	NC	NC	NC	860		2,000		1,000		570		530	U	690	
Selenium	3.9	180	1,500	6,800	2.20	U	2.20	U	2.10	U	2.20	U	2.10	U	2.10	U
Silver	2	180	1,500	6,800	0.22	U	0.22	U	0.21	U	0.22	U	0.21	U	0.21	U
Sodium	NC	NC	NC	NC	310		320		270	U	280	U	260	U	260	U
Thallium	NC	NC	NC	NC	0.43	U	0.43	U	0.43	U	0.44	U	0.42	U	0.42	U
Vanadium	NC	NC	NC	NC	15.0		20.0		16.0		11.0		11.0	U	11.0	U
Zinc	109	10,000	10,000	10,000	25.0		30.0		28.0		20.0		42.0		22.0	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

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U - Non-detect

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Table 3
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

SAMPLE ID:					**TRC-SB-07 (0-2)**		**TRC-SB-07 (4-6)**		**TRC-SB-08 (0-2)**		**TRC-SB-08 (6-8)**		**TRC-SB-09 (0-2)**		**TRC-SB-09 (4-6)**	
LABORATORY SAMPLE ID:					AD16095-003		AD16095-004		AD16013-005		AD16013-006		AD16013-001		AD16013-002	
DATE SAMPLE COLLECTED:					3/6/2020		3/6/2020		3/3/2020		3/3/2020		3/3/2020		3/3/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	2,900		3,100		3,300		3,600		4,400		5,800	
Antimony	NC	NC	NC	NC	0.84	U	0.84	U	0.87	U	0.87	U	0.99	U	0.99	U
Arsenic	13	16	16	16	0.54		0.41		8.40		10.0		6.20		2.00	
Barium	350	400	400	10,000	22.0		26.0		39.0		55.0		200.0		36.0	
Beryllium	7.2	72	590	2,700	0.21	U	0.21	U	0.22	U	0.22	U	0.25	U	0.23	U
Cadmium	2.5	4.3	9.3	60	0.42	U	0.42	U	0.43	U	0.43	U	0.67		0.47	U
Calcium	NC	NC	NC	NC	1,100	U	1,100	U	1,200		4,800		22,000		1,200	U
Chromium	30	180	1,500	6,800	7.10		5.90		11.0		15.0		19.0		12.0	
Cobalt	NC	NC	NC	NC	3.80		3.90		5.60		4.00		5.80		7.60	
Copper	50	270	270	10,000	7.70		7.60		18.0		46.0		**310**		14.0	
Iron	NC	NC	NC	NC	8,800		7,300		11,000		12,000		17,000		13,000	
Lead	63	400	1,000	3,900	5.30	U	5.30	U	43.0		**110**		**690**		12.0	
Magnesium	NC	NC	NC	NC	1,100		1,100		1,500		2,100		2,500		2,400	
Manganese	1,600	2,000	10,000	10,000	190		210		280		160		290		330	
Mercury	0.18	0.81	2.8	5.7	0.088	U	0.088	U	0.091	U	0.091	U	**1.10**		0.097	U
Nickel	30	310	310	10,000	6.40		6.30		19.0		14.0		24.0		**33.0**	
Potassium	NC	NC	NC	NC	530	U	530	U	540	U	580		840		1,000	
Selenium	3.9	180	1,500	6,800	2.10	U	2.10	U	2.20	U	2.20	U	2.50	U	2.30	U
Silver	2	180	1,500	6,800	0.21	U	0.21	U	0.22	U	0.22	U	0.25	U	0.23	U
Sodium	NC	NC	NC	NC	260	U	260	U	270	U	270	U	540		290	U
Thallium	NC	NC	NC	NC	0.42	U	0.42	U	0.43	U	0.43	U	0.49	U	0.47	U
Vanadium	NC	NC	NC	NC	14.0		12.0		14.0		14.0		17.0		18.0	
Zinc	109	10,000	10,000	10,000	14.0		13.0		87.0		**220**		**280**		34.0	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

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Table 3
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

SAMPLE ID:					**TRC-SB-10 (0-2)**		**TRC-SB-10 (4-6)**		**TRC-SB-11 (0-2)**		**TRC-SB-11 (4-6)**		**TRC-SB-12 (0-2)**		**TRC-SB-12 (3-5)**	
LABORATORY SAMPLE ID:					AD16041-008		AD16041-009		AD16071-007		AD16071-008		AD16041-003		AD16041-004	
DATE SAMPLE COLLECTED:					3/4/2020		3/4/2020		3/5/2020		3/5/2020		3/4/2020		3/4/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	2,800		2,900		2,900		3,000		9,400		2,100	
Antimony	NC	NC	NC	NC	0.87	U	0.85	U	1.20		3.50		1.70		1.30	
Arsenic	13	16	16	16	**190**		0.88		**50.0**		**31.0**		**120**		0.69	
Barium	350	400	400	10,000	130.0		33.0		63.0		110.0		230.0		13.0	
Beryllium	7.2	72	590	2,700	0.23		0.21	U	0.23		0.23	U	0.26		0.23	U
Cadmium	2.5	4.3	9.3	60	0.43	U	0.43	U	0.74		1.20		0.82		0.46	U
Calcium	NC	NC	NC	NC	14,000		1,100	U	1,600		3,600		15,000		1,100	U
Chromium	30	180	1,500	6,800	18.0		7.50	U	9.90		12.0		15.0		5.70	U
Cobalt	NC	NC	NC	NC	5.90		3.30		5.00		5.40		23.0		2.90	U
Copper	50	270	270	10,000	**83.0**		6.40		**52.0**		**73.0**		**260**		5.70	U
Iron	NC	NC	NC	NC	29,000		11,000		11,000		29,000		41,000		7,500	
Lead	63	400	1,000	3,900	**200**		5.30	U	**130**		**630**		**310**		5.70	U
Magnesium	NC	NC	NC	NC	7,600		1,300		1,600		1,300		5,200		830	
Manganese	1,600	2,000	10,000	10,000	270		170		200		290		470		93.0	
Mercury	0.18	0.81	2.8	5.7	**0.260**		0.089	U	**0.30**		**0.63**		**0.42**		0.096	U
Nickel	30	310	310	10,000	20.0		6.60		12.0		16.0		27.0		5.70	U
Potassium	NC	NC	NC	NC	540	U	530	U	550		570	U	1,800		570	U
Selenium	3.9	180	1,500	6,800	2.20	U	2.10	U	2.20	U	2.30	U	2.20	U	2.30	U
Silver	2	180	1,500	6,800	0.22	U	0.21	U	0.22	U	0.23	U	0.22	U	0.23	U
Sodium	NC	NC	NC	NC	350		270	U	270	U	280	U	670		290	U
Thallium	NC	NC	NC	NC	0.43	U	0.43	U	0.44	U	0.45	U	0.45	U	0.46	U
Vanadium	NC	NC	NC	NC	35.0		16.0		20.0		17.0		88.0		12.0	
Zinc	109	10,000	10,000	10,000	**160**		35.0		**140**		**390**		**660**		44.0	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
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New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

				SAMPLE ID:	**TRC-SB-13 (0-2)**		**TRC-SB-13 (6-8)**		**TRC-SB-14 (0-2)**		**TRC-SB-14 (4-6)**		**TRC-SB-15 (0-2)**		**TRC-SB-15 (9-11)**	
				LABORATORY SAMPLE ID:	AD16071-009		AD16071-010		AD16095-001		AD16095-002		AD16095-005		AD16095-006	
				DATE SAMPLE COLLECTED:	3/5/2020		3/5/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	4,100		3,100		5,500		6,200		7,500		3,500	
Antimony	NC	NC	NC	NC	0.86	U	0.84	U	0.86	U	0.90	U	0.85	U	0.88	U
Arsenic	13	16	16	16	1.90		1.40		2.20		**27.0**		0.96		0.42	
Barium	350	400	400	10,000	23.0		16.0		36.0		44.0		77.0		27.0	
Beryllium	7.2	72	590	2,700	0.22	U	0.21	U	0.22	U	0.26		0.21	U	0.22	U
Cadmium	2.5	4.3	9.3	60	0.43	U	0.42	U	0.43	U	0.45	U	0.43	U	0.44	U
Calcium	NC	NC	NC	NC	2,600		1,100	U	35,000		7,400		1,100	U	5,400	
Chromium	30	180	1,500	6,800	8.00		8.00		14.0		13.0		15.0		13.0	
Cobalt	NC	NC	NC	NC	4.70		4.00		7.00		6.40		7.60		3.20	
Copper	50	270	270	10,000	10.0		6.20		46.0		17.0		13.0		7.20	
Iron	NC	NC	NC	NC	9,900		9,600		17,000		12,000		16,000		6,900	
Lead	63	400	1,000	3,900	17.0		8.30		26.0		31.0		5.30	U	5.50	U
Magnesium	NC	NC	NC	NC	1,900		1,700		13,000		5,300		2,900		1,900	
Manganese	1,600	2,000	10,000	10,000	200		180		200		240		310		220	
Mercury	0.18	0.81	2.8	5.7	0.09	U	0.088	U	0.09	U	0.094	U	0.089	U	0.092	U
Nickel	30	310	310	10,000	13.0		13.0		13.0		19.0		29.0		11.0	
Potassium	NC	NC	NC	NC	570		530	U	900		1,100		1,800		670	
Selenium	3.9	180	1,500	6,800	2.20	U	2.10	U	2.20	U	2.20	U	2.10	U	2.20	U
Silver	2	180	1,500	6,800	0.22	U	0.21	U	0.22	U	0.22	U	0.21	U	0.22	U
Sodium	NC	NC	NC	NC	270	U	260	U	350		280	U	670		360	
Thallium	NC	NC	NC	NC	0.43	U	0.42	U	0.43	U	0.45	U	0.43	U	0.44	U
Vanadium	NC	NC	NC	NC	13.0		11.0		44.0		22.0		20.0		11.0	U
Zinc	109	10,000	10,000	10,000	29.0		22.0		89.0		58.0		42.0		19.0	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.
U - Non-detect
J - Estimated value

Table 3
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

				SAMPLE ID:	TRC-SB-16 (0-2)		TRC-SB-16 (8-10)		TRC-SB-17 (0-2)		TRC-SB-17 (15-17)		TRC-SB-18 (0-2)		TRC-SB-18 (5-7)	
				LABORATORY SAMPLE ID:	AD16107-005		AD16107-006		AD16013-007		AD16013-008		AD16041-001		AD16041-002	
				DATE SAMPLE COLLECTED:	3/9/2020		3/9/2020		3/3/2020		3/3/2020		3/4/2020		3/4/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	8,900		3,200		2,600		2,700		940		4,300	
Antimony	NC	NC	NC	NC	0.89	U	0.93	U	0.86	U	0.85	U	0.83	U	0.84	U
Arsenic	13	16	16	16	2.40		1.20		0.50		0.49		1.40		1.80	
Barium	350	400	400	10,000	69.0		19.0		18.0		29.0		10.0	U	28.0	
Beryllium	7.2	72	590	2,700	0.35		0.25		0.22	U	0.21	U	0.21	U	0.21	U
Cadmium	2.5	4.3	9.3	60	0.44	U	0.47	U	0.43	U	0.43	U	0.42	U	0.42	U
Calcium	NC	NC	NC	NC	1,100		1,200	U	1,100	U	1,300		30,000		1,100	
Chromium	30	180	1,500	6,800	21.0		5.80	U	7.80		8.50		5.20	U	10.0	
Cobalt	NC	NC	NC	NC	9.60		3.30		2.70		3.20		2.60	U	5.80	
Copper	50	270	270	10,000	15.0		6.70		8.70		12.0		5.20	U	9.00	
Iron	NC	NC	NC	NC	18,000		7,500		6,700		6,900		3,100		11,000	
Lead	63	400	1,000	3,900	8.50		5.80	U	12.0		7.60		13.0		10.0	
Magnesium	NC	NC	NC	NC	3,500		1,900		1,700		1,800		13,000		2,300	
Manganese	1,600	2,000	10,000	10,000	370		200		190		240		97.0		260	
Mercury	0.18	0.81	2.8	5.7	0.093	U	0.097	U	0.090	U	0.089	U	0.087	U	0.088	U
Nickel	30	310	310	10,000	**33.0**		10.0		11.0		12.0		7.70		17.0	
Potassium	NC	NC	NC	NC	2,300		580	U	600		590		520	U	790	
Selenium	3.9	180	1,500	6,800	2.20	U	2.30	U	2.20	U	2.10	U	2.10	U	2.10	U
Silver	2	180	1,500	6,800	0.22	U	0.23	U	0.22	U	0.21	U	0.21	U	0.21	U
Sodium	NC	NC	NC	NC	280	U	290	U	270	U	270	U	260	U	260	U
Thallium	NC	NC	NC	NC	0.44	U	0.47	U	0.43	U	0.43	U	0.42	U	0.42	U
Vanadium	NC	NC	NC	NC	31.0		12.0	U	11.0	U	11.0		42.0		16.0	
Zinc	109	10,000	10,000	10,000	76.0		24.0		25.0		27.0		24.0		68.0	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 3
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

SAMPLE ID:					**TRC-SB-19 (0-2)**		**TRC-SB-19 (7-9)**		**TRC-SB-20 (0-2)**		**TRC-SB-20 (6-8)**		**TRC-SB-21 (0-2)**		**TRC-SB-21 (6-8)**	
LABORATORY SAMPLE ID:					AD16041-006		AD16041-007		AD16107-007		AD16107-008		AD16107-001		AD16107-002	
DATE SAMPLE COLLECTED:					3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/9/2020		3/9/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	2,600		3,700		1,600		4,100		2,400		4,200	
Antimony	NC	NC	NC	NC	0.86	U	0.91	U	3.10		0.88	U	0.86	U	0.88	U
Arsenic	13	16	16	16	**25.0**		1.00		8.40		1.00		3.20		1.60	
Barium	350	400	400	10,000	37.0		22.0		59.0		48.0		45.0		20.0	
Beryllium	7.2	72	590	2,700	0.22	U	0.23	U	0.25		0.22	U	0.22	U	0.22	U
Cadmium	2.5	4.3	9.3	60	0.86		0.45	U	0.65		0.44	U	0.43	U	0.44	U
Calcium	NC	NC	NC	NC	48,000		1,100	U	1,100	U	1,400		92,000		1,100	U
Chromium	30	180	1,500	6,800	**39.0**		9.60		18.0		16.0		8.70		8.00	
Cobalt	NC	NC	NC	NC	8.40		3.80		12.0		5.40		3.70		4.50	
Copper	50	270	270	10,000	**160**		7.30		**150**		12.0		16.0		7.40	
Iron	NC	NC	NC	NC	37,000		8,400		130,000		11,000		7,000		10,000	
Lead	63	400	1,000	3,900	**110**		5.70	U	**210**		12.0		48.0		5.50	U
Magnesium	NC	NC	NC	NC	24,000		2,000		560	U	2,800		41,000		2,000	
Manganese	1,600	2,000	10,000	10,000	300		230		720		220		160		240	
Mercury	0.18	0.81	2.8	5.7	0.09	U	0.095	U	**0.230**		0.092	U	0.09	U	0.092	U
Nickel	30	310	310	10,000	**33.0**		12.0		24.0		21.0		8.10		11.0	
Potassium	NC	NC	NC	NC	540	U	710		560	U	1,100		630		650	
Selenium	3.9	180	1,500	6,800	2.20	U	2.30	U	2.20	U	2.20	U	2.20	U	2.20	U
Silver	2	180	1,500	6,800	0.22	U	0.23	U	0.22	U	0.22	U	0.22	U	0.22	U
Sodium	NC	NC	NC	NC	270	U	280	U	310		280		330		270	U
Thallium	NC	NC	NC	NC	0.43	U	0.45	U	0.44	U	0.44	U	0.43	U	0.44	U
Vanadium	NC	NC	NC	NC	29.0		13.0		56.0	U	16.0		23.0		11.0	U
Zinc	109	10,000	10,000	10,000	**110**		31.0		**540**		**280**		61.0		54.0	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.
U - Non-detect
J - Estimated value

Table 3
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Metals

SAMPLE ID:					**TRC-SB-22 (0-2)**		**TRC-SB-22 (6-8)**		**TRC-DUP-01**		**TRC-DUP-02**		**TRC-DUP-03**	
LABORATORY SAMPLE ID:					AD16107-003		AD16107-004		AD16041-005		AD16095-017		AD16107-009	
DATE SAMPLE COLLECTED:					3/9/2020		3/9/2020		3/4/2020		3/6/2020		3/9/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	NC	9,400		5,000		2,700		3,500		3,900	
Antimony	NC	NC	NC	NC	0.91	U	0.91	U	1.20		0.84	U	4.90	
Arsenic	13	16	16	16	**66.0**		2.70		0.820		0.620		**210**	
Barium	350	400	400	10,000	36.0		12.0		22.0		26.0		140	
Beryllium	7.2	72	590	2,700	0.73		0.34		0.22	U	0.21	U	0.36	
Cadmium	2.5	4.3	9.3	60	0.45	U	0.45	U	0.43	U	0.42	U	0.53	
Calcium	NC	NC	NC	NC	3,300		1,100	U	1,100	U	1,100	U	3,000	
Chromium	30	180	1,500	6,800	13.0		10.0		6.50		9.10		28.0	
Cobalt	NC	NC	NC	NC	6.00		6.60		3.30		4.30		12.0	
Copper	50	270	270	10,000	**220**		5.70	U	7.40		6.30		**330**	
Iron	NC	NC	NC	NC	14,000		16,000		8,500		10,000		58,000	
Lead	63	400	1,000	3,900	**290**		5.70	U	5.40	U	5.30	U	**390**	
Magnesium	NC	NC	NC	NC	2,100		1,000		1,100		1,100		630	
Manganese	1,600	2,000	10,000	10,000	130		350		160		200		600	
Mercury	0.18	0.81	2.8	5.7	**0.21**		0.095	U	0.09	U	0.088	U	**0.70**	
Nickel	30	310	310	10,000	**34.0**		6.30		6.00		7.60		28.0	
Potassium	NC	NC	NC	NC	720		610		540	U	530	U	0.44	U
Selenium	3.9	180	1,500	6,800	2.30	U	2.30	U	2.20	U	2.10	U	0.44	U
Silver	2	180	1,500	6,800	0.23	U	0.23	U	0.22	U	0.21	U	0.44	U
Sodium	NC	NC	NC	NC	280	U	280	U	270	U	260	U	360	
Thallium	NC	NC	NC	NC	0.45	U	0.45	U	0.43	U	0.42	U	0.45	U
Vanadium	NC	NC	NC	NC	21.0		19.0		14.0		16.0		38.0	
Zinc	109	10,000	10,000	10,000	**150**		28.0		52.0		17.0		**180**	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.
U - Non-detect
J - Estimated value

Table 4
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

SAMPLE ID:					**TRC-SB-01 (0-2)**		**TRC-SB-01 (4-6)**		**TRC-SB-02 (0-2)**		**TRC-SB-02 (4-6)**		**TRC-SB-03 (0-2)**		**TRC-SB-03 (5-7)**		**TRC-SB-04 (0-2)**	
LABORATORY SAMPLE ID:					AD16013-003		AD16013-004		AD16071-001		AD16071-002		AD16071-003		AD16071-004		AD16071-005	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.028	U	0.030	U	0.027	U	0.027	U
Aroclor-1221	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.028	U	0.030	U	0.027	U	0.027	U
Aroclor-1232	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.028	U	0.030	U	0.027	U	0.027	U
Aroclor-1242	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.028	U	0.030	U	0.027	U	0.027	U
Aroclor-1248	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.028	U	0.030	U	0.027	U	0.027	U
Aroclor-1254	NC	NC	NC	NC	0.029	U	0.026	U	0.290		0.082		0.030	U	0.027	U	0.027	U
Aroclor-1260	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.028	U	0.030	U	0.027	U	0.027	U
Aroclor-1262	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.098		0.030	U	0.027	U	0.027	U
Aroclor-1268	NC	NC	NC	NC	0.029	U	0.026	U	0.027	U	0.028	U	0.030	U	0.027	U	0.027	U
Aroclor (Total)	0.1	1	1	25	0.029	U	0.026	U	**0.290**		**0.180**		0.030	U	0.027	U	0.027	U

Notes
TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 4
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

SAMPLE ID:					**TRC-SB-04 (5-7)**		**TRC-SB-05 (0-2)**		**TRC-SB-05 (5-7)**		**TRC-SB-06 (0-2)**		**TRC-SB-06 (6-8)**		**TRC-SB-07 (0-2)**		**TRC-SB-07 (4-6)**	
LABORATORY SAMPLE ID:					AD16071-006		AD16041-010		AD16041-011		AD16095-007		AD16095-008		AD16095-003		AD16095-004	
DATE SAMPLE COLLECTED:					3/5/2020		3/4/2020		3/4/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1221	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1232	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1242	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1248	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1254	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1260	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1262	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor-1268	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U
Aroclor (Total)	0.1	1	1	25	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U	0.026	U	0.026	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective
Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 4
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

				SAMPLE ID:	**TRC-SB-08 (0-2)**		**TRC-SB-08 (6-8)**		**TRC-SB-09 (0-2)**		**TRC-SB-09 (4-6)**		**TRC-SB-10 (0-2)**		**TRC-SB-10 (4-6)**		**TRC-SB-11 (0-2)**	
				LABORATORY SAMPLE ID:	AD16013-005		AD16013-006		AD16013-001		AD16013-002		AD16041-008		AD16041-009		AD16071-007	
				DATE SAMPLE COLLECTED:	3/3/2020		3/3/2020		3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/5/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.027	U	0.027	U	0.027	U
Aroclor-1221	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.027	U	0.027	U	0.027	U
Aroclor-1232	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.027	U	0.027	U	0.027	U
Aroclor-1242	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.027	U	0.027	U	0.027	U
Aroclor-1248	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.740		0.027	U	0.580	
Aroclor-1254	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.027	U	0.027	U	0.027	U
Aroclor-1260	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.027	U	0.027	U	0.027	U
Aroclor-1262	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.097		0.027	U	0.027	U
Aroclor-1268	NC	NC	NC	NC	0.027	U	0.027	U	0.031	U	0.029	U	0.027	U	0.027	U	0.027	U
Aroclor (Total)	0.1	1	1	25	0.027	U	0.027	U	0.031	U	0.029	U	**0.840**		0.027	U	**0.580**	

Notes
TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 4
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

SAMPLE ID:					TRC-SB-11 (4-6)		TRC-SB-12 (0-2)		TRC-SB-12 (3-5)		TRC-SB-13 (0-2)		TRC-SB-13 (6-8)		TRC-SB-14 (0-2)		TRC-SB-14 (4-6)	
LABORATORY SAMPLE ID:					AD16071-008		AD16041-003		AD16041-004		AD16071-009		AD16071-010		AD16095-001		AD16095-002	
DATE SAMPLE COLLECTED:					3/5/2020		3/4/2020		3/4/2020		3/5/2020		3/5/2020		3/6/2020		3/6/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor-1221	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor-1232	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor-1242	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor-1248	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor-1254	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor-1260	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.033		0.210	
Aroclor-1262	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor-1268	NC	NC	NC	NC	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.027	U	0.028	U
Aroclor (Total)	0.1	1	1	25	0.028	U	0.028	U	0.029	U	0.027	U	0.026	U	0.033		**0.210**	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 4
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

				SAMPLE ID:	TRC-SB-15 (0-2)		TRC-SB-15 (9-11)		TRC-SB-16 (0-2)		TRC-SB-16 (8-10)		TRC-SB-17 (0-2)		TRC-SB-17 (15-17)		TRC-SB-18 (0-2)	
				LABORATORY SAMPLE ID:	AD16095-005		AD16095-006		AD16107-005		AD16107-006		AD16013-007		AD16013-008		AD16041-001	
				DATE SAMPLE COLLECTED:	3/6/2020		3/6/2020		3/9/2020		3/9/2020		3/3/2020		3/3/2020		3/4/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor-1221	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor-1232	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor-1242	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor-1248	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor-1254	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor-1260	NC	NC	NC	NC	0.027	U	0.027	U	0.036		0.029	U	0.027	U	0.027	U	0.075	
Aroclor-1262	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor-1268	NC	NC	NC	NC	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.052	U
Aroclor (Total)	0.1	1	1	25	0.027	U	0.027	U	0.036		0.029	U	0.027	U	0.027	U	0.075	

Notes
TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 4
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

				SAMPLE ID:	TRC-SB-18 (5-7)		TRC-SB-19 (0-2)		TRC-SB-19 (7-9)		TRC-SB-20 (0-2)		TRC-SB-20 (6-8)		TRC-SB-21 (0-2)		TRC-SB-21 (6-8)	
				LABORATORY SAMPLE ID:	AD16041-002		AD16041-006		AD16041-007		AD16107-007		AD16107-008		AD16107-001		AD16107-002	
				DATE SAMPLE COLLECTED:	3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/9/2020		3/9/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	NC	0.026	U	0.054	U	0.028	U	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1221	NC	NC	NC	NC	0.026	U	0.054	U	0.028	U	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1232	NC	NC	NC	NC	0.026	U	0.054	U	0.028	U	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1242	NC	NC	NC	NC	0.026	U	0.054	U	0.028	U	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1248	NC	NC	NC	NC	0.026	U	0.130		0.028	U	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1254	NC	NC	NC	NC	0.026	U	0.054	U	0.028	U	0.028	U	0.027	U	0.420		0.027	U
Aroclor-1260	NC	NC	NC	NC	0.026	U	0.200		0.028	U	0.140		0.027	U	0.027	U	13.0	
Aroclor-1262	NC	NC	NC	NC	0.026	U	0.054	U	0.028	U	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1268	NC	NC	NC	NC	0.026	U	0.054	U	0.028	U	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor (Total)	0.1	1	1	25	0.026	U	**0.330**		0.028	U	**0.140**		0.027	U	**0.420**		**13.0**	

Notes
TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 4
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

SAMPLE ID:					TRC-SB-22 (0-2)		TRC-SB-22 (6-8)		TRC-DUP-01		TRC-DUP-02		TRC-DUP-03	
LABORATORY SAMPLE ID:					AD16107-003		AD16107-004		AD16041-005		AD16095-017		AD16107-009	
DATE SAMPLE COLLECTED:					3/9/2020		3/9/2020		3/4/2020		3/6/2020		3/9/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Industrial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor-1221	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor-1232	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor-1242	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor-1248	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor-1254	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor-1260	NC	NC	NC	NC	0.068		0.028	U	0.027	U	0.026	U	0.120	
Aroclor-1262	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor-1268	NC	NC	NC	NC	0.028	U	0.028	U	0.027	U	0.026	U	0.028	U
Aroclor (Total)	0.1	1	1	25	0.068		0.028	U	0.027	U	0.026	U	**0.120**	

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)

TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)

TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds

U - Non-detect

J - Estimated value

Table 5
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Pesticides

SAMPLE ID:					TRC-SB-01 (0-2)		TRC-SB-01 (4-6)		TRC-SB-02 (0-2)		TRC-SB-02 (4-6)		TRC-SB-03 (0-2)		TRC-SB-03 (5-7)		TRC-SB-04 (0-2)		TRC-SB-04 (5-7)		TRC-SB-05 (0-2)		TRC-SB-05 (5-7)		TRC-SB-06 (0-2)		TRC-SB-06 (6-8)	
LABORATORY SAMPLE ID:					AD16013-003		AD16013-004		AD16071-001		AD16071-002		AD16071-003		AD16071-004		AD16071-005		AD16071-006		AD16041-010		AD16041-011		AD16095-007		AD16095-008	
DATE SAMPLE COLLECTED:					3/3/2020		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/4/2020		3/4/2020		3/6/2020		3/6/2020	
PESTICIDES (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
a-Chlordane	0.094	4.2	24	47	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Aldrin	0.005	0.097	0.68	1.4	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Alpha-BHC	0.02	0.48	3.4	6.8	0.0011	U	0.0010	U	0.0054	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
beta-BHC	0.036	0.36	3	14	0.0011	U	0.0010	U	0.0054	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Chlordane (Total)	0.094	4.2	24	47	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
delta-BHC	0.04	100	500	1,000	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Dieldrin	0.005	0.2	1.4	2.8	0.0011	U	0.0010	U	0.0054	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Endosulfan I	2.4	24	200	920	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Endosulfan II	2.4	24	200	920	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Endosulfan Sulfate	2.4	24	200	920	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Endrin	0.014	11	89	410	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Endrin Aldehyde	NC	NC	NC	NC	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Endrin Ketone	NC	NC	NC	NC	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
gamma-BHC	0.1	1.3	9.2	23	0.0011	U	0.0010	U	0.0054	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Heptachlor	0.042	2.1	15	29	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Heptachlor Epoxide	NC	NC	NC	NC	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
Methoxychlor	NC	NC	NC	NC	0.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U
p,p'-DDD	0.0033	13	92	180	0.0029	U	0.0026	U	0.014	U	0.0033		0.0030	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0028	U	0.0026	U	0.0026	U
p,p'-DDE	0.0033	8.9	62	120	0.0029	U	0.0026	U	0.014	U	**0.014**		0.0030	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0028	U	0.0026	U	0.0026	U
p,p'-DDT	0.0033	7.9	47	94	0.0029	U	0.0026	U	0.014	U	**0.030**		0.0030	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0028	U	0.0026	U	0.0026	U
Toxaphene	NC	NC	NC	NC	0.029	U	0.026	U	0.140	U	0.028	U	0.030	U	0.027	U	0.027	U	0.027	U	0.027	U	0.028	U	0.026	U	0.026	U
y-Chlordane	NC	NC	NC	NC	1.0057	U	0.0052	U	0.027	U	0.0056	U	0.0060	U	0.0055	U	0.0054	U	0.0054	U	0.0053	U	0.0056	U	0.0053	U	0.0053	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 5
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Pesticides

SAMPLE ID:					TRC-SB-07 (0-2)		TRC-SB-07 (4-6)		TRC-SB-08 (0-2)		TRC-SB-08 (6-8)		TRC-SB-09 (0-2)		TRC-SB-09 (4-6)		TRC-SB-10 (0-2)		TRC-SB-10 (4-6)		TRC-SB-11 (0-2)		TRC-SB-11 (4-6)		TRC-SB-12 (0-2)		TRC-SB-12 (3-5)	
LABORATORY SAMPLE ID:					AD16095-003		AD16095-004		AD16013-005		AD16013-006		AD16013-001		AD16013-002		AD16041-008		AD16041-009		AD16071-007		AD16071-008		AD16041-003		AD16041-004	
DATE SAMPLE COLLECTED:					3/6/2020		3/6/2020		3/3/2020		3/3/2020		3/3/2020		3/3/2020		3/4/2020		3/4/2020		3/5/2020		3/5/2020		3/4/2020		3/4/2020	
PESTICIDES (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
a-Chlordane	0.094	4.2	24	47	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0067		0.0057	U	0.0056	U	0.0057	U
Aldrin	0.005	0.097	0.68	1.4	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Alpha-BHC	0.02	0.48	3.4	6.8	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0012	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
beta-BHC	0.036	0.36	3	14	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0012	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Chlordane (Total)	0.094	4.2	24	47	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.017		0.0057	U	0.0056	U	0.0057	U
delta-BHC	0.04	100	500	1,000	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Dieldrin	0.005	0.2	1.4	2.8	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0012	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Endosulfan I	2.4	24	200	920	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Endosulfan II	2.4	24	200	920	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Endosulfan Sulfate	2.4	24	200	920	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Endrin	0.014	11	89	410	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Endrin Aldehyde	NC	NC	NC	NC	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Endrin Ketone	NC	NC	NC	NC	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
gamma-BHC	0.1	1.3	9.2	23	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0012	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Heptachlor	0.042	2.1	15	29	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Heptachlor Epoxide	NC	NC	NC	NC	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056	U	0.0057	U
Methoxychlor	NC	NC	NC	NC	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0055	U	0.0057	U	0.0056		0.0057	U
p,p'-DDD	0.0033	13	92	180	0.0026	U	0.0026	U	0.0027	U	0.0027	U	0.0031	U	0.0029	U	0.014	U	0.0027	U	**0.027**		0.0028	U	**0.130**		0.0029	U
p,p'-DDE	0.0033	8.9	62	120	0.0026	U	0.0026	U	0.0027	U	0.0027	U	0.0031	U	0.0029	U	0.014	U	0.0027	U	**0.082**		0.0028	U	**0.690**		0.0029	U
p,p'-DDT	0.0033	7.9	47	94	0.0026	U	0.0026	U	0.0027	U	0.0027	U	0.0031	U	0.0029	U	0.014	U	0.0027	U	**0.150**		0.0028	U	**0.220**		0.0029	U
Toxaphene	NC	NC	NC	NC	0.026	U	0.026	U	0.027	U	0.027	U	0.031	U	0.029	U	0.14	U	0.027	U	0.027	U	0.028	U	0.028	U	0.029	U
y-Chlordane	NC	NC	NC	NC	0.0053	U	0.0053	U	0.0054	U	0.0054	U	0.0062	U	0.0058	U	0.027	U	0.0053	U	0.0067		0.0057	U	0.0056	U	0.0057	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 5
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Sampling Analytical Results for Pesticides

SAMPLE ID:					**TRC-SB-13 (0-2)**		**TRC-SB-13 (6-8)**		**TRC-SB-14 (0-2)**		**TRC-SB-14 (4-6)**		**TRC-SB-15 (0-2)**		**TRC-SB-15 (9-11)**		**TRC-SB-16 (0-2)**		**TRC-SB-16 (8-10)**		**TRC-SB-17 (0-2)**		**TRC-SB-17 (15-17)**		**TRC-SB-18 (0-2)**		**TRC-SB-18 (5-7)**	
LABORATORY SAMPLE ID:					AD16071-009		AD16071-010		AD16095-001		AD16095-002		AD16095-005		AD16095-006		AD16107-005		AD16107-006		AD16013-007		AD16013-008		AD16041-001		AD16041-002	
DATE SAMPLE COLLECTED:					3/5/2020		3/5/2020		3/6/2020		3/6/2020		3/6/2020		3/6/2020		3/9/2020		3/9/2020		3/3/2020		3/3/2020		3/4/2020		3/4/2020	
PESTICIDES (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
a-Chlordane	0.094	4.2	24	47	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Aldrin	0.005	0.097	0.68	1.4	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Alpha-BHC	0.02	0.48	3.4	6.8	0.0011	U	0.0011	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0052	U	0.0011	U
beta-BHC	0.036	0.36	3	14	0.0011	U	0.0011	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0052	U	0.0011	U
Chlordane (Total)	0.094	4.2	24	47	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
delta-BHC	0.04	100	500	1,000	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Dieldrin	0.005	0.2	1.4	2.8	0.0048		0.0011	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0052	U	0.0011	U
Endosulfan I	2.4	24	200	920	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Endosulfan II	2.4	24	200	920	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Endosulfan Sulfate	2.4	24	200	920	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Endrin	0.014	11	89	410	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Endrin Aldehyde	NC	NC	NC	NC	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Endrin Ketone	NC	NC	NC	NC	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
gamma-BHC	0.1	1.3	9.2	23	0.0011	U	0.0011	U	0.0054	U	0.0011	U	0.0011	U	0.0011	U	0.0011	U	0.0012	U	0.0011	U	0.0011	U	0.0052	U	0.0011	U
Heptachlor	0.042	2.1	15	29	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Heptachlor Epoxide	NC	NC	NC	NC	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
Methoxychlor	NC	NC	NC	NC	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U
p,p'-DDD	0.0033	13	92	180	0.0027	U	0.0026	U	0.013	U	0.0028	U	0.0027	U	0.0027	U	0.0028	U	0.0029	U	0.0027	U	0.0027	U	0.013	U	0.0026	U
p,p'-DDE	0.0033	8.9	62	120	0.0027	U	0.0026	U	0.013	U	0.0028	U	0.0027	U	0.0027	U	0.0028	U	0.0029	U	0.0027	U	0.0027	U	**0.016**		0.0026	U
p,p'-DDT	0.0033	7.9	47	94	0.0027	U	0.0026	U	0.013	U	0.0028	U	0.0027	U	0.0027	U	0.0028	U	0.0029	U	0.0027	U	0.0027	U	0.013	U	0.0026	U
Toxaphene	NC	NC	NC	NC	0.027	U	0.026	U	0.13	U	0.028	U	0.027	U	0.027	U	0.028	U	0.029	U	0.027	U	0.027	U	0.13	U	0.026	U
y-Chlordane	NC	NC	NC	NC	0.0054	U	0.0053	U	0.027	U	0.0056	U	0.0053	U	0.0055	U	0.0056	U	0.0058	U	0.0054	U	0.0053	U	0.026	U	0.0053	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
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TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)
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Summary of Soil Sampling Analytical Results for Pesticides

SAMPLE ID:					TRC-SB-19 (0-2)		TRC-SB-19 (7-9)		TRC-SB-20 (0-2)		TRC-SB-20 (6-8)		TRC-SB-21 (0-2)		TRC-SB-21 (6-8)		TRC-SB-22 (0-2)		TRC-SB-22 (6-8)		TRC-DUP-01		TRC-DUP-02		TRC-DUP-03	
LABORATORY SAMPLE ID:					AD16041-006		AD16041-007		AD16107-007		AD16107-008		AD16107-001		AD16107-002		AD16107-003		AD16107-004		AD16041-005		AD16095-017		AD16107-009	
DATE SAMPLE COLLECTED:					3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/9/2020		3/9/2020		3/9/2020		3/9/2020		3/4/2020		3/6/2020		3/9/2020	
PESTICIDES (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
a-Chlordane	0.094	4.2	24	47	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Aldrin	0.005	0.097	0.68	1.4	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Alpha-BHC	0.02	0.48	3.4	6.8	0.0011	U	0.0011	U	0.0022	U	0.0011	U	0.0054	U	0.0011	U	0.0023	U	0.0011	U	0.0011	U	0.0011	U	0.0023	U
beta-BHC	0.036	0.36	3	14	0.0011	U	0.0011	U	0.0022	U	0.0011	U	0.0054	U	0.0011	U	0.0023	U	0.0011	U	0.0011	U	0.0011	U	0.0023	U
Chlordane (Total)	0.094	4.2	24	47	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
delta-BHC	0.04	100	500	1,000	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Dieldrin	0.005	0.2	1.4	2.8	0.0011	U	0.0011	U	0.0022	U	0.0011	U	0.0054	U	0.0011	U	0.0023	U	0.0011	U	0.0011	U	0.0011	U	0.0023	U
Endosulfan I	2.4	24	200	920	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Endosulfan II	2.4	24	200	920	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Endosulfan Sulfate	2.4	24	200	920	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Endrin	0.014	11	89	410	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Endrin Aldehyde	NC	NC	NC	NC	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Endrin Ketone	NC	NC	NC	NC	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
gamma-BHC	0.1	1.3	9.2	23	0.0011	U	0.0011	U	0.0022	U	0.0011	U	0.0054	U	0.0011	U	0.0023	U	0.0011	U	0.0011	U	0.0011	U	0.0023	U
Heptachlor	0.042	2.1	15	29	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Heptachlor Epoxide	NC	NC	NC	NC	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
Methoxychlor	NC	NC	NC	NC	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U
p,p'-DDD	0.0033	13	92	180	0.0026	U	0.0028	U	**0.040**		0.0027	U	0.013	U	0.0027	U	0.0057	U	0.0028	U	0.0027	U	0.0026	U	**0.046**	
p,p'-DDE	0.0033	8.9	62	120	0.0026	U	0.0028	U	**0.043**		0.0027	U	0.013	U	0.0027	U	0.0057	U	0.0028	U	0.0027	U	0.0026	U	**0.025**	
p,p'-DDT	0.0033	7.9	47	94	0.0026	U	0.0028	U	**0.085**		0.0027	U	0.013	U	0.0027	U	0.0057	U	0.0028	U	0.0027	U	0.0026	U	**0.050**	
Toxaphene	NC	NC	NC	NC	0.026	U	0.028	U	0.056	U	0.027	U	0.13	U	0.027	U	0.057	U	0.028	U	0.027	U	0.026	U	0.057	U
y-Chlordane	NC	NC	NC	NC	0.0053	U	0.0057	U	0.011	U	0.0055	U	0.027	U	0.0055	U	0.011	U	0.0057	U	0.0054	U	0.0053	U	0.011	U

Notes

TRC-DUP-01 is a duplicate of sample TRC-SB-12 (3-5)
TRC-DUP-02 is a duplicate of sample TRC-SB-07 (4-6)
TRC-DUP-03 is a duplicate of sample TRC-SB-20 (0-2)

mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 6
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Volatile Organic Compounds

SAMPLE ID:		TRC-GW-01		TRC-GW-02		TRC-GW-03		TRC-GW-04		TRC-GW-05		TRC-GW-07		TRC-GW-10		TRC-GW-11		TRC-GW-13		TRC-GW-14		TRC-GW-15		TRC-GW-16		TRC-GW-17		TRC-GW-18		TRC-GW-19		TRC-GW-21		TRC-GW-22		TRC-GW-DUP-01		TRC-TB-20200309	
LABORATORY SAMPLE ID:		AD16012-001		AD16071-013		AD16071-014		AD16071-015		AD16071-011		AD16095-13		AD16044-005		AD16095-09		AD16107-012		AD16095-011		AD16107-010		AD16107-014		AD16044-001		AD16044-003		AD16044-007		AD16107-018		AD16107-016		AD16095-015		AD16095-020	
DATE SAMPLE COLLECTED:		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/6/2020		3/9/2020		3/6/2020		3/9/2020		3/9/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020		3/9/2020	
VOLATILE ORGANIC COMPOUNDS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
1,1,1-Trichloroethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	3.60		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,1,2,2-Tetrachloroethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,1,2-Trichloro-1,2,2-trifluoroethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,1,2-Trichloroethane	1	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,1-Dichloroethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	**16.0**		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,1-Dichloroethene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	**35.0**		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,2,3-Trichlorobenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,2,4-Trichlorobenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,2,4-Trimethylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,2-Dibromo-3-chloropropane	0.04	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,2-Dibromoethane	0.0006	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,2-Dichlorobenzene	3	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,2-Dichloroethane	0.6	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
1,2-Dichloropropane	1	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,3,5-Trimethylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,3-Dichlorobenzene	3	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,4-Dichlorobenzene	3	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
1,4-Dioxane	NC	50.00	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	59.0		50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
2-Butanone	50	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
2-Hexanone	50	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
4-Isopropyltoluene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
4-Methyl-2-pentanone	50	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Acetone	50	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U	5.00	U
Benzene	1	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
Bromochloromethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Bromodichloromethane	50	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Bromoform	50	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Bromomethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Carbon disulfide	60	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Carbon tetrachloride	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Chlorobenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Chloroethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Chloroform	7	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.80		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Chloromethane	5	1.00	U	1.00	U	2.00		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
cis-1,2-Dichloroethene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	**16.0**		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	2.90		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
cis-1,3-Dichloropropene	0.4(2)	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Cyclohexane	NC	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Dibromochloromethane	50	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Dichlorodifluoromethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Ethylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00		1.00	U	1.00	U
Isopropylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.80		1.00	U	1.00	U
m&p-Xylenes	5	1.20		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Methyl Acetate	NC	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Methylcyclohexane	NC	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Methylene chloride	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Methyl-t-butyl ether	10	0.50	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
n-Butylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
n-Propylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	2.20		1.00	U	1.00	U
o-Xylene	NC	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
sec-Butylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	2.70		1.00	U	1.00	U
Styrene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
t-Butylbenzene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Tetrachloroethene	5	1.00	U	**9.30**		3.40		1.00	U	4.80		1.00	U	**35.0**		1.00	U	1.00	U	1.00	U	1.00	U	2.70		**32.0**		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Toluene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
trans-1,2-Dichloroethene	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
trans-1,3-Dichloropropene	0.4(2)	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Trichloroethene	5	1.00	U	1.00	U	**8.30**		1.00	U	1.00	U	1.00	U	**85.0**		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	4.90		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Trichlorofluoromethane	5	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Vinyl chloride	2	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Xylenes (Total)	5(1)	1.20		1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U

Notes

(1) - There is no GA value for total xylenes. The standards for o-xylene, m-xylene, and p-xylene is 5 µg/L.

(2) - 0.4 µg/L applies to the sum of cis- and trans-1,3-dichloropropene.

µg/L - micrograms per liter

NC - No criterion

U - Non-detect

Shaded and **bold** results exceed the corresponding Class GA Value.

TRC-GW-DUP-01 is a duplicate of sample TRC-GW-14

Table 7
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:		**TRC-GW-01**		**TRC-GW-02**		**TRC-GW-03**		**TRC-GW-04**		**TRC-GW-05**		**TRC-GW-07**		**TRC-GW-10**		**TRC-GW-11**		**TRC-GW-13**		**TRC-GW-14**		**TRC-GW-15**		**TRC-GW-16**		**TRC-GW-17**		**TRC-GW-18**		**TRC-GW-19**		**TRC-GW-21**		**TRC-GW-22**		**TRC-GW-DUP-01**	
LABORATORY SAMPLE ID:		AD16012-001		AD16071-013		AD16071-014		AD16071-015		AD16071-011		AD16095-13		AD16044-005		AD16095-09		AD16107-012		AD16095-011		AD16107-010		AD16107-014		AD16044-001		AD16044-003		AD16044-007		AD16107-018		AD16107-016		AD16095-015	
DATE SAMPLE COLLECTED:		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/6/2020		3/9/2020		3/6/2020		3/9/2020		3/9/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
1,1'-Biphenyl	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
1,2,4,5-Tetrachlorobenzene	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2,3,4,6-Tetrachlorophenol	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2,4,5-Trichlorophenol	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2,4,6-Trichlorophenol	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2,4-Dichlorophenol	5	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
2,4-Dimethylphenol	50	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
2,4-Dinitrophenol	10	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	11.0	U	11.0	U	10.0	U	11.0	U	10.0	U	10.0	U	10.0	U	11.0	U	10.0	U	11.0	U
2,4-Dinitrotoluene	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2,6-Dinitrotoluene	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2-Chloronaphthalene	10	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2-Chlorophenol	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2-Methylnaphthalene	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	60.0		2.10	U
2-Methylphenol	NC	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
2-Nitroaniline	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
2-Nitrophenol	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
3&4-Methylphenol	NC	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
3,3'-Dichlorobenzidine	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
3-Nitroaniline	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
4,6-Dinitro-2-methylphenol	NC	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	11.0	U	11.0	U	10.0	U	11.0	U	10.0	U	10.0	U	10.0	U	11.0	U	10.0	U	11.0	U
4-Bromophenyl-phenylether	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
4-Chloro-3-methylphenol	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
4-Chloroaniline	5	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
4-Chlorophenyl-phenylether	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
4-Nitroaniline	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
4-Nitrophenol	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Acenaphthene	20	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Acenaphthylene	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10		2.10	U
Acetophenone	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Anthracene	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Atrazine	7.5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Benzaldehyde	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Benzo[a]anthracene	0.002	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Benzo[a]pyrene	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Benzo[b]fluoranthene	0.002	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Benzo[g,h,i]perylene	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Benzo[k]fluoranthene	0.002	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
bis(2-Chloroethoxy)methane	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
bis(2-Chloroethyl)ether	1	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
bis(2-Chloroisopropyl)ether	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
bis(2-Ethylhexyl)phthalate	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Butylbenzylphthalate	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Caprolactam	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Carbazole	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Chrysene	0.002	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Dibenzo[a,h]anthracene	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Dibenzofuran	NC	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	5.60		0.530	U
Diethylphthalate	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Dimethylphthalate	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Di-n-butylphthalate	50	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
Di-n-octylphthalate	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Fluoranthene	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Fluorene	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	4.50		2.10	U
Hexachlorobenzene	0.04	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Hexachlorobutadiene	0.5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Hexachlorocyclopentadiene	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Hexachloroethane	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Indeno[1,2,3-cd]pyrene	0.002	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Isophorone	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Naphthalene	10	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	**11.0**		0.530	U
Nitrobenzene	0.4	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
N-Nitroso-di-n-propylamine	NC	0.500	U	0.510	U	0.510	U	0.510	U	0.510	U	0.500	U	0.500	U	0.510	U	0.530	U	0.540	U	0.510	U	0.540	U	0.500	U	0.500	U	0.500	U	0.530	U	0.520	U	0.530	U
N-Nitrosodiphenylamine	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Pentachlorophenol	1	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	11.0	U	11.0	U	10.0	U	11.0	U	10.0	U	10.0	U	10.0	U	11.0	U	10.0	U	11.0	U
Phenanthrene	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	6.20		2.10	U
Phenol	1	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U
Pyrene	50	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.10	U	2.20	U	2.00	U	2.20	U	2.00	U	2.00	U	2.00	U	2.10	U	2.10	U	2.10	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results exceed the corresponding Class GA Value.
TRC-GW-DUP-01 is a duplicate of sample TRC-GW-14

Table 8
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Metals

	SAMPLE ID:	**TRC-GW-01**		**TRC-GW-02**		**TRC-GW-03**		**TRC-GW-04**		**TRC-GW-05**		**TRC-GW-07**		**TRC-GW-10**		**TRC-GW-11**		**TRC-GW-13**	
	LABORATORY SAMPLE ID:	AD16012-001		AD16071-013		AD16071-014		AD16071-015		AD16071-011		AD16095-13		AD16044-005		AD16095-09		AD16107-012	
	DATE SAMPLE COLLECTED:	3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/6/2020		3/9/2020	
METALS (UNFILTERED) (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
Aluminum	2,000	1,300		550		**7,700**		**12,000**		**18,000**		**42,000**		1,300		520		**51,000**	
Antimony	3	**8.80**		**15.0**		3.00	U	**10.0**		**6.30**		3.00	U	3.00	U	**7.40**		3.00	U
Arsenic	25	4.90		2.00	U	4.50		7.40		11.0		22.0		2.00	U	23.0		21.0	
Barium	1,000	140		120		130		150		98.0		390		180		160		110	
Beryllium	3	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	4.00	U	1.00	U	1.00	U	12.0	U
Cadmium	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Calcium	NC	97,000		37,000		16,000		14,000		5,800		44,000		86,000		70,000		61,000	
Chromium	50	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	**150**		50.0	U	50.0	U	**110**	
Cobalt	NC	2.50		2.00	U	7.30		14.0		7.50		52.0		2.10		2.00	U	36.0	
Copper	200	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	94.0		50.0	U	50.0	U	110	
Iron	300	**2,500**		**800**		**9,300**		**19,000**		**22,000**		**88,000**		**1,500**		**1,100**		**110,000**	
Lead	25	25.0		3.00	U	3.30		24.0		9.50		**39.0**		3.00	U	**44.0**		**59.0**	
Magnesium	35,000	18,000		7,900		6,200		6,400		5,000	U	22,000		14,000		16,000		30,000	
Manganese	300	170		57.0		**480**		**1,300**		**420**		**2,500**		**10,000**		77.0		**2,400**	
Mercury	0.7	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
Nickel	100	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	**200**		50.0	U	50.0	U	100	
Potassium	NC	7,800		7,100		5,000	U	7,300		5,000	U	19,000		6,100		14,000		20,000	
Selenium	10	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	**15.0**		10.0	U	10.0	U	10.0	U
Silver	50	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U
Sodium	20,000	**44,000**		**150,000**		**150,000**		**50,000**		**95,000**		**270,000**		**170,000**		**100,000**		**82,000**	
Thallium	0.5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Vanadium	NC	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	160		50.0	U	50.0	U	280	
Zinc	2,000	160		50.0	U	50.0	U	78.0		59.0		220		50.0	U	52.0		200	

	SAMPLE ID:	**TRC-GW-01**		**TRC-GW-02**		**TRC-GW-03**		**TRC-GW-04**		**TRC-GW-05**		**TRC-GW-07**		**TRC-GW-10**		**TRC-GW-11**		**TRC-GW-13**	
	LABORATORY SAMPLE ID:	AD16012-002		AD16071-014		AD16071-016		AD16071-018		AD16071-012		AD16095-14		AD16044-006		AD16095-10		AD16107-013	
	DATE SAMPLE COLLECTED:	3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/6/2020		3/9/2020	
METALS (FILTERED) (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
Aluminum	2,000	200	U	200	U	200	U	200	U	360		200	U	200	U	200	U	200	U
Antimony	3	**8.60**		**15.0**		3.00	U	**17.0**		**5.50**		3.00	U	3.00	U	**7.40**		3.00	U
Arsenic	25	2.00	U	2.00	U	3.00		2.10		4.50		2.00	U	2.00	U	21.0		2.00	U
Barium	1,000	110		120		62.0	U	50.0	U	50.0	U	57.0		170		130		50.0	U
Beryllium	3	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Cadmium	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Calcium	NC	120,000		38,000		18,000		14,000		5,000	U	24,000		88,000		68,000		59,000	
Chromium	50	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Cobalt	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Copper	200	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Iron	300	300	U	300	U	300	U	300	U	**430**		300	U	300	U	300	U	300	U
Lead	25	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U
Magnesium	35,000	21,000		7,900		5,000	U	5,000	U	5,000	U	7,800		14,000		15,000		12,000	
Manganese	300	130		40.0	U	40.0	U	40.0	U	40.0	U	41.0		**10,000**		56.0		**970**	
Mercury	0.7	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
Nickel	100	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Potassium	NC	8,900		6,800		5,000	U	5,400		5,000	U	12,000		5,800		13,000		10,000	
Selenium	10	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
Silver	50	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U
Sodium	20,000	**54,000**		**160,000**		**180,000**		**76,000**		**110,000**		**290,000**		**170,000**		**100,000**		**85,000**	
Thallium	0.5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Vanadium	NC	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Zinc	2,000	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results exceed corresponding Class GA Value.
TRC-GW-DUP-01 is a duplicate of sample TRC-GW-14

Table 8
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Metals

	SAMPLE ID:	**TRC-GW-14**		**TRC-GW-15**		**TRC-GW-16**		**TRC-GW-17**		**TRC-GW-18**		**TRC-GW-19**		**TRC-GW-21**		**TRC-GW-22**		**TRC-GW-DUP-01**	
	LABORATORY SAMPLE ID:	AD16095-011		AD16107-010		AD16107-014		AD16044-001		AD16044-003		AD16044-007		AD16107-018		AD16107-016		AD16095-015	
	DATE SAMPLE COLLECTED:	3/6/2020		3/9/2020		3/9/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020	
METALS (UNFILTERED) (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
Aluminum	2,000	**6,600**		**4,500**		**180,000**		**3,600**		1,900		990		**2,100**		**6,000**		**120,000**	
Antimony	3	3.00	U	**46.0**		3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U
Arsenic	25	9.20		4.70		**95.0**		2.00	U	2.00	U	2.00	U	6.40		13.0		**73.0**	
Barium	1,000	55.0		74.0		**1,900**		110		130		110		52.0		170		860	
Beryllium	3	1.00	U	1.00	U	30	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Cadmium	5	2.00	U	2.00	U	**9.50**		2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Calcium	NC	39,000		32,000		120,000		31,000		110,000		69,000		27,000		37,000		100,000	
Chromium	50	50.0	U	50.0	U	**620**		50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	**230**	
Cobalt	NC	7.00		5.00		270		3.60		2.00	U	2.00	U	5.70		5.10		110	
Copper	200	50.0	U	50.0	U	**770**		50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	**360**	
Iron	300	**23,000**		**7,000**		**410,000**		**4,600**		**2,100**		**1,300**		**8,200**		**63,000**		**190,000**	
Lead	25	**63.0**		5.90		**350**		3.00	U	3.00	U	3.00	U	8.50		16.0		**320**	
Magnesium	35,000	12,000		7,500		**130,000**		6,200		13,000		12,000		5,000	U	5,700		**63,000**	
Manganese	300	**2,400**		**530**		**37,000**		**1,400**		130		**340**		**620**		**3,100**		**4,700**	
Mercury	0.7	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.540	
Nickel	100	50.0	U	50.0	U	**990**		50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	**350**	
Potassium	NC	11,000		5,000	U	65,000		5,000	U	5,000	U	7,900		5,000	U	6,600		34,000	
Selenium	10	10.0	U	10.0	U	**35.0**		10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	**16.0**	
Silver	50	20.0	U	20.0	U	80	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U
Sodium	20,000	**170,000**		**52,000**		**34,000**		**330,000**		18,000		**110,000**		**40,000**		**47,000**		**150,000**	
Thallium	0.5	2.00	U	2.00	U	**2.50**		2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Vanadium	NC	50.0	U	50.0	U	500		50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	340	
Zinc	2,000	55.0		50.0	U	1,300		50.0	U	110		50.0	U	100		67.0		790	

	SAMPLE ID:	**TRC-GW-14**		**TRC-GW-15**		**TRC-GW-16**		**TRC-GW-17**		**TRC-GW-18**		**TRC-GW-19**		**TRC-GW-21**		**TRC-GW-22**		**TRC-GW-DUP-01**	
	LABORATORY SAMPLE ID:	AD16095-012		AD16107-011		AD16107-015		AD16044-002		AD16044-004		AD16044-008		AD16107-019		AD16107-017		AD16095-016	
	DATE SAMPLE COLLECTED:	3/6/2020		3/9/2020		3/9/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020	
METALS (FILTERED) (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
Aluminum	2,000	200	U	200	U	200	U	200	U	200	U	200	U	200	U	200	U	200	U
Antimony	3	3.00	U	**46.0**		3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U
Arsenic	25	3.60		2.10		2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	9.70		4.50	
Barium	1,000	50.0	U	50.0	U	62.0		97.0		99.0		95.0		50.0	U	130		76.0	
Beryllium	3	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U	1.00	U
Cadmium	5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Calcium	NC	35,000		32,000		48,000		35,000		97,000		65,000		28,000		37,000		66,000	
Chromium	50	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Cobalt	NC	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	13.0	
Copper	200	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Iron	300	**12,000**		300	U	300	U	300	U	300	U	300	U	300	U	**54,000**		**990**	
Lead	25	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U	3.00	U
Magnesium	35,000	8,600		5,100		8,800		5,900		12,000		11,000		5,000	U	5,000	U	11,000	
Manganese	300	**2,300**		42.0		**330**		**1,600**		47.0		210		280		**3,100**		**2,200**	
Mercury	0.7	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U	0.500	U
Nickel	100	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Potassium	NC	10,000		5,000	U	8,000		5,000	U	5,000	U	7,200		5,000	U	5,500		7,900	
Selenium	10	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U	10.0	U
Silver	50	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U	20.0	U
Sodium	20,000	**180,000**		**54,000**		**30,000**		**380,000**		17,000		**100,000**		**42,000**		**47,000**		**95,000**	
Thallium	0.5	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U	2.00	U
Vanadium	NC	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U	50.0	U
Zinc	2,000	50.0	U	50.0	U	50.0	U	50.0	U	83.0		50.0	U	59.0		50.0	U	50.0	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results exceed corresponding Class GA Value.

TRC-GW-DUP-01 is a duplicate of sample TRC-GW-14

Table 9
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Polychlorinated Biphenyls

SAMPLE ID:		TRC-GW-01		TRC-GW-02		TRC-GW-03		TRC-GW-04		TRC-GW-05		TRC-GW-07		TRC-GW-10		TRC-GW-11		TRC-GW-13	
LABORATORY SAMPLE ID:		AD16012-001		AD16071-013		AD16071-014		AD16071-015		AD16071-011		AD16095-13		AD16044-005		AD16095-09		AD16107-012	
DATE SAMPLE COLLECTED:		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/6/2020		3/9/2020	
POLYCHLORINATED BIPHENYLS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
PCB-1016 (Aroclor 1016)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1221 (Aroclor 1221)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1232 (Aroclor 1232)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1242 (Aroclor 1242)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1248 (Aroclor 1248)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1254 (Aroclor 1254)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1260 (Aroclor 1260)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1262 (Aroclor 1262)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
PCB-1268 (Aroclor 1268)	NC	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U
Total PCBs	0.09	0.250	U	0.250	U	0.250	U	0.250	U	0.250	U	0.310	U	0.250	U	0.250	U	0.260	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results exceed corresponding Class GA Value.
TRC-GW-DUP-01 is a duplicate of sample TRC-GW-14

Table 9
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Polychlorinated Biphenyls

SAMPLE ID:		**TRC-GW-14**		**TRC-GW-15**		**TRC-GW-16**		**TRC-GW-17**		**TRC-GW-18**		**TRC-GW-19**		**TRC-GW-21**		**TRC-GW-22**		**TRC-GW-DUP-01**	
LABORATORY SAMPLE ID:		AD16095-011		AD16107-010		AD16107-014		AD16044-001		AD16044-003		AD16044-007		AD16107-018		AD16107-016		AD16095-015	
DATE SAMPLE COLLECTED:		3/6/2020		3/9/2020		3/9/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020	
POLYCHLORINATED BIPHENYLS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
PCB-1016 (Aroclor 1016)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1221 (Aroclor 1221)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1232 (Aroclor 1232)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1242 (Aroclor 1242)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1248 (Aroclor 1248)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1254 (Aroclor 1254)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1260 (Aroclor 1260)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1262 (Aroclor 1262)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
PCB-1268 (Aroclor 1268)	NC	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U
Total PCBs	0.09	0.260	U	0.250	U	0.250	U	0.260	U	0.250	U	0.250	U	0.250	U	0.250	U	0.260	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results exceed corresponding Class GA Value.
TRC-GW-DUP-01 is a duplicate of sample TRC-GW-14

Table 10
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Pesticides

SAMPLE ID:		TRC-GW-01		TRC-GW-02		TRC-GW-03		TRC-GW-04		TRC-GW-05		TRC-GW-07		TRC-GW-10		TRC-GW-11		TRC-GW-13	
LABORATORY SAMPLE ID:		AD16012-001		AD16071-013		AD16071-014		AD16071-015		AD16071-011		AD16095-13		AD16044-005		AD16095-09		AD16107-012	
DATE SAMPLE COLLECTED:		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/6/2020		3/9/2020	
PESTICIDES (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
a-Chlordane	0.05	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Aldrin	ND	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Alpha-BHC	0.01	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
beta-BHC	0.04	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Chlordane (Total)	0.05	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
delta-BHC	0.04	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Dieldrin	0.004	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Endosulfan I	NC	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Endosulfan II	NC	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Endosulfan Sulfate	NC	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Endrin	ND	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Endrin Aldehyde	5	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Endrin Ketone	5	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
gamma-BHC	0.05	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Heptachlor	0.04	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Heptachlor Epoxide	0.03	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Methoxychlor	35	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
p,p'-DDD	0.3	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
p,p'-DDE	0.2	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
p,p'-DDT	0.2	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U
Toxaphene	0.06	0.250	U	0.25	U	0.25	U	0.25	U	0.25	U	0.31	U	0.25	U	0.25	U	0.25	U
y-Chlordane	0.05	0.010	U	0.010	U	0.010	U	0.010	U	0.010	U	0.013	U	0.010	U	0.010	U	0.010	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results
exceed corresponding Class GA Value.
TRC-GW-DUP-01 is a
duplicate of sample TRC-GW-14

Table 10
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Groundwater Sampling Analytical Results for Pesticides

SAMPLE ID:		TRC-GW-14		TRC-GW-15		TRC-GW-16		TRC-GW-17		TRC-GW-18		TRC-GW-19		TRC-GW-21		TRC-GW-22		TRC-GW-DUP-01	
LABORATORY SAMPLE ID:		AD16095-011		AD16107-010		AD16107-014		AD16044-001		AD16044-003		AD16044-007		AD16107-018		AD16107-016		AD16095-015	
DATE SAMPLE COLLECTED:		3/6/2020		3/9/2020		3/9/2020		3/4/2020		3/4/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020	
PESTICIDES (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
a-Chlordane	0.05	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Aldrin	ND	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Alpha-BHC	0.01	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
beta-BHC	0.04	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Chlordane (Total)	0.05	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
delta-BHC	0.04	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Dieldrin	0.004	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Endosulfan I	NC	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Endosulfan II	NC	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Endosulfan Sulfate	NC	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Endrin	ND	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Endrin Aldehyde	5	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Endrin Ketone	5	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
gamma-BHC	0.05	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Heptachlor	0.04	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Heptachlor Epoxide	0.03	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Methoxychlor	35	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
p,p'-DDD	0.3	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
p,p'-DDE	0.2	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
p,p'-DDT	0.2	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U
Toxaphene	0.06	0.26	U	0.25	U	0.25	U	0.26	U	0.25	U	0.25	U	0.25	U	0.25	U	0.26	U
y-Chlordane	0.05	0.010	U	0.010	U	0.010	U	0.011	U	0.010	U	0.010	U	0.010	U	0.010	U	0.011	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results
exceed corresponding Class GA Value.
TRC-GW-DUP-01 is a
duplicate of sample TRC-GW-14

Table 11
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Vapor, Indoor Air, and Ambient Air Analytical Results for Select Volatile Organic Compounds

SAMPLE NAME		**TRC-SV-01**		**TRC-SV-02**		**TRC-SV-03**		**TRC-SV-04**		**TRC-SV-05**		**TRC-SV-07**		**TRC-SV-10**		**TRC-SV-11**	
LABORATORY ID NO.		L2009476-01		L2010018-02		L2010018-03		L2010018-05		L2010018-01		L2010414-04		L2009712-01		L2010018-04	
DATE SAMPLE COLLECTED		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/5/2020	
MATRIX		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR	
VOLATILE ORGANIC COMPOUND ($\mu g/m^3$)	NYSDOH AGV	Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)	
1,1,1-Trichloroethane	NC	1.82		2.43		36.9		4.54	U	1.14		3.90	U	43.3		2.18	U
1,1,2,2-Tetrachloroethane	NC	1.37	U	1.37	U	1.37	U	5.72	U	1.37	U	4.90	U	0.475		2.75	U
1,1,2-Trichloroethane	NC	1.09	U	1.09	U	1.09	U	4.54	U	1.09	U	3.90	U	1.40	U	2.18	U
1,1-Dichloroethane	NC	0.809	U	0.809	U	3.64		3.37	U	0.809	U	2.89	U	0.511	U	1.62	U
1,1-Dichloroethene	NC	0.793	U	0.793	U	3.31		3.30	U	0.793	U	2.83	U	10.4		1.59	U
1,2,4-Trichlorobenzene	NC	1.48	U	1.48	U	1.48	U	6.18	U	1.48	U	5.30	U	0.777	U	2.97	U
1,2,4-Trimethylbenzene	NC	9.98		3.57		3.79		6.64		4.97		6.64		0.776		6.44	
1,2-Dibromoethane	NC	1.54	U	1.54	U	1.54	U	6.40	U	1.54	U	5.49	U	19.0		3.07	U
1,2-Dichlorobenzene	NC	1.20	U	1.20	U	1.20	U	5.01	U	1.20	U	4.29	U	0.874	U	2.40	U
1,2-Dichloroethane	NC	0.809	U	0.809	U	0.809	U	3.37	U	0.809	U	2.89	U	720		1.62	U
1,2-Dichloropropane	NC	0.924	U	0.924	U	0.924	U	3.85	U	0.924	U	3.30	U	1.12	U	1.85	U
1,3,5-Trimethylbenzene	NC	2.87		1.05		1.08		4.10	U	1.47		3.51	U	3.02		1.97	U
1,3-Butadiene	NC	8.74		0.442	U	3.01		4.20		0.821		1.88		153		0.885	U
1,3-Dichlorobenzene	NC	1.20	U	1.20	U	1.20	U	5.01	U	1.20	U	4.29	U	1.52	U	2.40	U
1,4-Dichlorobenzene	NC	1.20	U	1.20	U	1.20	U	5.01	U	1.20	U	4.29	U	1.74	U	2.40	U
1,4-Dioxane	NC	0.721	U	0.721	U	0.721	U	3.00	U	0.721	U	2.57	U	0.626	U	1.44	U
2,2,4-Trimethylpentane	NC	1.17		5.93		6.07		3.89	U	0.934	U	3.33	U	1.02		12.20	
2-Butanone	NC	36.9		17.2		36.3		154		14.5		165		1.53	U	62.2	
2-Hexanone	NC	13.10		4.51		13.1		35.60		3.96		40.0		0.793	U	16.10	
3-Chloropropene	NC	0.626	U	0.626	U	0.626	U	2.61	U	0.626	U	2.23	U	117		1.25	U
4-Ethyltoluene	NC	2.26		0.983	U	0.983	U	4.10	U	0.983		3.51	U	0.721	U	1.97	U
4-Methyl-2-pentanone	NC	2.73		2.05	U	2.05	U	8.52	U	2.05	U	7.29	U	42.5		4.10	U
Acetone	NC	264		530		518		1,570		249		1,900		44.8		850	
Benzene	NC	3.67		1.48		4.22		4.89		0.677		2.80		1.80	U	3.77	
Benzyl chloride	NC	1.04	U	1.04	U	1.04	U	4.31	U	1.04	U	3.70	U	6.74		2.07	U
Bromodichloromethane	NC	1.34	U	1.34	U	1.34	U	5.58	U	1.34	U	4.78	U	3.13		2.68	U
Bromoform	NC	2.07	U	2.07	U	2.07	U	8.61	U	2.07	U	7.38	U	0.809	U	4.14	U
Bromomethane	NC	0.777	U	0.777	U	0.777	U	3.23	U	0.777	U	2.77	U	5.36		1.55	U
Carbon disulfide	NC	2.74		2.71		1.19		3.15		0.623	U	2.22	U	43.3		3.21	
Carbon tetrachloride	NC	1.26	U	1.26	U	1.26	U	5.24	U	1.26	U	4.49	U	3.51		2.52	U
Chlorobenzene	NC	0.921	U	0.921	U	0.921	U	3.84	U	0.921	U	3.29	U	1.26	U	1.84	U
Chloroethane	NC	0.528	U	0.528	U	0.528	U	2.20	U	0.528	U	1.88	U	1.42		1.06	U

Table 11
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Vapor, Indoor Air, and Ambient Air Analytical Results for
Select Volatile Organic Compounds

SAMPLE NAME		**TRC-SV-01**		**TRC-SV-02**		**TRC-SV-03**		**TRC-SV-04**		**TRC-SV-05**		**TRC-SV-07**		**TRC-SV-10**		**TRC-SV-11**	
LABORATORY ID NO.		L2009476-01		L2010018-02		L2010018-03		L2010018-05		L2010018-01		L2010414-04		L2009712-01		L2010018-04	
DATE SAMPLE COLLECTED		3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/5/2020	
MATRIX		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR	
VOLATILE ORGANIC COMPOUND ($\mu g/m^3$)	NYSDOH AGV	Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)	
Chloroform	NC	0.977	U	0.977	U	3.28		4.07	U	1.47		3.49	U	0.924	U	1.95	U
Chloromethane	NC	0.413	U	0.442		0.673		1.72	U	0.413	U	1.47	U	1.34	U	0.999	
cis-1,2-Dichloroethene	NC	0.793	U	0.793	U	1.44		3.30	U	0.793	U	2.83	U	0.721	U	1.59	U
cis-1,3-Dichloropropene	NC	0.908	U	0.908	U	0.908	U	3.78	U	0.908	U	3.24	U	177		1.820	U
Cyclohexane	NC	3.30		2.57		6.13		4.27		0.688	U	2.46	U	0.934	U	10.8	
Dibromochloromethane	NC	1.70	U	1.70	U	1.70	U	7.10	U	1.70	U	6.08	U	5.66		3.41	U
Dichlorodifluoromethane	NC	2.38		2.16		2.10		4.12	U	2.08		3.53	U	0.908	U	2.29	
Ethanol	NC	16.3		14.8		14.4		39.2	U	9.42	U	51.1		2.05	U	18.8	U
Ethyl Acetate	NC	1.80	U	1.80	U	1.80	U	7.50	U	1.80	U	6.41	U	0.908	U	3.60	U
Ethylbenzene	NC	7.30		4.78		4.52		7.30		3.31		7.12		1.09	U	6.65	
Freon-113	NC	1.53	U	1.53	U	1.53	U	6.38	U	1.53	U	5.47	U	11.4		3.07	U
Freon-114	NC	1.40	U	1.40	U	1.40	U	5.82	U	1.40	U	4.99	U	12.70		2.80	U
Heptane	NC	10.2		3.27		5.90		10.6		1.61		8.73		1.70	U	11.1	
Hexachlorobutadiene	NC	2.13	U	2.13	U	2.13	U	8.89	U	2.13	U	7.62	U	1.54	U	4.27	U
Isopropanol	NC	1.61		3.59		2.93		8.55		1.23	U	13.8		153		2.46	U
Methyl tert butyl ether	NC	0.721	U	0.721	U	0.721	U	3.00	U	0.721	U	2.57	U	0.921	U	1.44	U
Methylene chloride	60	1.74	U	1.74	U	1.74	U	7.23	U	1.74	U	6.18	U	1.74	U	3.47	U
n-Hexane	NC	7.89		1.99		6.31		7.15		1.24		4.30		17.9		17.6	
o-Xylene	NC	6.65		4.14		3.42		5.91		3.25		5.82		2.07	U	5.34	
p/m-Xylene	NC	15.4		10.1		8.21		13.7		7.56		14.3		0.852	U	12.7	
Styrene	NC	0.852	U	0.852	U	0.852	U	3.55	U	0.852	U	3.04	U	1.37	U	1.70	U
Tertiary butyl Alcohol	NC	4.91		3.73		4.70		12.2		1.52	U	14.8		7.73		5.06	
Tetrachloroethene	30	78.7		59.3		57.2		132		384		86.1		1.92		92.2	
Tetrahydrofuran	NC	1.47	U	3.63		1.47	U	6.13	U	1.47	U	5.25	U	2.86		2.95	U
Toluene	NC	9.27		12.2		12.7		13.2		3.69		11.9		9.68		12.1	
trans-1,2-Dichloroethene	NC	0.793	U	0.793	U	0.793	U	3.30	U	0.793	U	2.83	U	1.04	U	1.59	U
trans-1,3-Dichloropropene	NC	0.908	U	0.908	U	0.908	U	3.78	U	0.908	U	3.24	U	1.20	U	1.82	U
Trichloroethene	2	1.07	U	1.07	U	29.6		4.48	U	2.10		3.84	U	177		2.15	U
Trichlorofluoromethane	NC	1.48		1.15		1.12	U	4.68	U	1.12	U	4.01	U	1.20	U	2.25	U
Vinyl bromide	NC	0.874	U	0.874	U	0.874	U	3.64	U	0.874	U	3.12	U	1.48	U	1.75	U
Vinyl chloride	NC	0.511	U	0.511	U	0.511	U	2.13	U	0.511	U	1.83	U	2.13	U	1.02	U
Total BTEX	NC	42.29		32.70		33.07		45.0		18.49		41.94		9.68		40.56	

Notes:

$\mu g/m^3$ - Micrograms per cubic meter

NC - No Criteria

U - Non-detect

NYS AGV - New York State Department of
Health Aire Guideline Values

*Only the results of indoor air samples
were compared to the NYSDOH AGVs

Table 11
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Vapor, Indoor Air, and Ambient Air Analytical Results for Select Volatile Organic Compounds

SAMPLE NAME	**TRC-SV-12**		**TRC-SV-13**		**TRC-SV-14**		**TRC-SV-16**		**TRC-SV-17**		**TRC-SV-20**		**TRC-SV-22**		**TRC-BLDG-57**		**TRC-BLDG-58**		**TRC-AA-01**	
LABORATORY ID NO.	L2009712-02		L2010018-06		L2010414-03		L2010462-01		L2009712-03		L2010462-03		L2010462-02		L2010414-01		L2009476-02		L2010414-02	
DATE SAMPLE COLLECTED	3/4/2020		3/5/2020		3/6/2020		3/9/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020		3/3/2020		3/6/2020	
MATRIX	SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		INDOOR AIR		INDOOR AIR		AMBIENT AIR	
VOLATILE ORGANIC COMPOUND (µg/m^3)	Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)	
1,1,1-Trichloroethane	1.09	U	2.18	U	3.21	U	3.03	U	1.09	U	5.46	U	9.11	U	0.109	U	0.109	U	0.109	U
1,1,2,2-Tetrachloroethane	0.661		2.75	U	4.04	U	3.82	U	0.413	U	6.87	U	11.5	U	1.37	U	1.37	U	1.37	U
1,1,2-Trichloroethane	1.40	U	2.18	U	3.21	U	3.03	U	1.40	U	5.46	U	9.11	U	1.09	U	1.09	U	1.09	U
1,1-Dichloroethane	0.511	U	1.62	U	2.38	U	2.25	U	0.511	U	4.05	U	10.9		0.809	U	0.809	U	0.809	U
1,1-Dichloroethene	11.2		1.59	U	2.33	U	2.20	U	0.442	U	3.96	U	6.62	U	0.079	U	0.079	U	0.079	U
1,2,4-Trichlorobenzene	0.777	U	2.97	U	4.36	U	4.13	U	0.777	U	7.42	U	12.4	U	1.48	U	1.48	U	1.48	U
1,2,4-Trimethylbenzene	0.528	U	5.85		7.47		5.90		0.528	U	17.2		10.2		0.983	U	0.983	U	0.983	U
1,2-Dibromoethane	15.7		3.07	U	4.52	U	4.27	U	9.42	U	7.69	U	12.8	U	1.54	U	1.54	U	1.54	U
1,2-Dichlorobenzene	1.20	U	2.40	U	3.54	U	3.34	U	0.874	U	6.01	U	10.0	U	1.20	U	1.20	U	1.20	U
1,2-Dichloroethane	380		1.62	U	2.38	U	2.25	U	123		4.05	U	6.76	U	0.809	U	0.809	U	0.809	U
1,2-Dichloropropane	1.12	U	1.85	U	2.72	U	2.57	U	1.12	U	4.62	U	7.72	U	0.924	U	0.924	U	0.924	U
1,3,5-Trimethylbenzene	1.79		1.97	U	2.89	U	2.73	U	1.23	U	4.92	U	8.21	U	0.983	U	0.983	U	0.983	U
1,3-Butadiene	0.793	U	0.885	U	1.30	U	79.0		0.793	U	30.3		3.69	U	0.442	U	0.442	U	0.442	U
1,3-Dichlorobenzene	1.52	U	2.40	U	3.54	U	3.34	U	1.59		6.01	U	10.0	U	1.20	U	1.20	U	1.20	U
1,4-Dichlorobenzene	1.74	U	2.40	U	3.54	U	3.34	U	1.74	U	6.01	U	10.0	U	1.20	U	1.20	U	1.20	U
1,4-Dioxane	0.626	U	1.44	U	2.12	U	2.00	U	0.626	U	3.60	U	6.02	U	0.721	U	0.721	U	0.721	U
2,2,4-Trimethylpentane	2.60		1.87	U	2.75	U	2.60	U	0.623	U	10.9		7.80	U	0.934	U	0.934	U	0.934	U
2-Butanone	1.53	U	110		136		142		1.53	U	277		295		1.47	U	1.47	U	1.47	U
2-Hexanone	0.79	U	27.7		36.8		47.9		0.793	U	83.2		6.84	U	0.820	U	0.820	U	0.820	U
3-Chloropropene	0.809	U	1.25	U	1.84	U	1.74	U	0.809	U	3.13	U	5.23	U	0.626	U	0.626	U	0.626	U
4-Ethyltoluene	0.721	U	1.97	U	2.89	U	2.73	U	0.721	U	4.92	U	8.21	U	0.983	U	0.983	U	0.983	U
4-Methyl-2-pentanone	30.1		4.10	U	6.02	U	5.70	U	10.8		10.2	U	17.1	U	2.05	U	2.05	U	2.05	U
Acetone	0.793	U	1,240		1,580		1,390		0.793	U	3,780		4,300		6.27		6.51		4.92	
Benzene	1.80	U	1.50		1.88	U	17.1		1.80	U	5.27		54.6		0.869		0.728		0.706	
Benzyl chloride	0.977	U	2.07	U	3.04	U	2.88	U	0.977	U	5.18	U	8.65	U	1.04	U	1.04	U	1.04	U
Bromodichloromethane	1.47	U	2.68	U	3.94	U	3.72	U	1.47	U	6.70	U	11.2	U	1.34	U	1.34	U	1.34	U
Bromoform	0.809	U	4.14	U	6.08	U	5.75	U	0.809	U	10.3	U	17.3	U	2.07	U	2.07	U	2.07	U
Bromomethane	9.23		1.55	U	2.28	U	2.16	U	0.705	U	3.88	U	6.48	U	0.777	U	0.777	U	0.777	U
Carbon disulfide	1.09	U	5.57		1.92		8.10		1.09	U	8.72		5.20	U	0.623	U	1.20		0.623	U
Carbon tetrachloride	3.71		2.52	U	3.70	U	3.50	U	0.639	U	6.29	U	10.5	U	0.428		0.415		0.384	
Chlorobenzene	1.26	U	1.84	U	2.71	U	2.56	U	1.26	U	4.61	U	7.69	U	0.921	U	0.921	U	0.921	U
Chloroethane	3.68		1.06	U	1.55	U	1.47	U	0.688	U	2.64	U	4.41	U	0.528	U	0.528	U	0.528	U

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Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Vapor, Indoor Air, and Ambient Air Analytical Results for Select Volatile Organic Compounds

SAMPLE NAME	**TRC-SV-12**		**TRC-SV-13**		**TRC-SV-14**		**TRC-SV-16**		**TRC-SV-17**		**TRC-SV-20**		**TRC-SV-22**		**TRC-BLDG-57**		**TRC-BLDG-58**		**TRC-AA-01**	
LABORATORY ID NO.	L2009712-02		L2010018-06		L2010414-03		L2010462-01		L2009712-03		L2010462-03		L2010462-02		L2010414-01		L2009476-02		L2010414-02	
DATE SAMPLE COLLECTED	3/4/2020		3/5/2020		3/6/2020		3/9/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020		3/3/2020		3/6/2020	
MATRIX	SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		INDOOR AIR		INDOOR AIR		AMBIENT AIR	
VOLATILE ORGANIC COMPOUND ($\mu g/m^3$)	Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)		Result ($\mu g/m^3$)	
Chloroform	0.924	U	1.95	U	2.87	U	4.61		0.924	U	4.88	U	8.16	U	0.977	U	0.977	U	0.977	U
Chloromethane	1.34	U	0.826	U	1.21	U	5.86		1.34	U	2.77		3.45	U	1.04		1.02		1.08	
cis-1,2-Dichloroethene	0.721	U	1.59	U	2.33	U	2.20	U	0.721	U	3.96	U	6.62	U	0.079	U	0.079	U	0.079	U
cis-1,3-Dichloropropene	1.07	U	1.82	U	2.67	U	2.52	U	1.07	U	4.54	U	7.58	U	0.908	U	0.908	U	0.908	U
Cyclohexane	0.934	U	2.60		2.02	U	5.20		0.934	U	13.0		238		0.688	U	0.688	U	0.688	U
Dibromochloromethane	8.07		3.41	U	5.01	U	4.74	U	1.55		8.52	U	14.2	U	1.70	U	1.70	U	1.70	U
Dichlorodifluoromethane	0.908	U	2.11		2.91	U	2.75	U	0.908	U	4.94	U	8.26	U	2.13		2.11		2.14	
Ethanol	2.05	U	40.1		27.7	U	35.8		2.05	U	92.1		80.5		72.0		124		13.5	
Ethyl Acetate	0.908	U	3.60	U	5.30	U	5.01	U	0.908	U	9.01	U	15.0	U	2.95		1.85		1.80	U
Ethylbenzene	1.09	U	5.95		7.12		7.08		1.09	U	11.4		97.3		0.87	U	0.87	U	0.87	U
Freon-113	8.10		3.07	U	4.51	U	4.26	U	4.90		7.66	U	12.8	U	1.53	U	1.53	U	1.53	U
Freon-114	16.1		2.80	U	4.11	U	3.89	U	5.41		6.99	U	11.7	U	1.40	U	1.40	U	1.40	U
Heptane	1.70	U	6.88		7.87		15.2		1.70	U	22.7		309		0.82	U	0.82	U	0.82	U
Hexachlorobutadiene	1.54	U	4.27	U	6.27	U	5.93	U	1.54	U	10.7	U	17.8	U	2.13	U	2.13	U	2.13	U
Isopropanol	63.1		8.85		9.37		16.6		79.3		52.4		10.3	U	3.74		36.9		1.23	U
Methyl tert butyl ether	0.921	U	1.44	U	2.12	U	2.00	U	0.921	U	3.61	U	6.02	U	0.721	U	0.721	U	0.721	U
Methylene chloride	1.73	U	7.96		5.11	U	4.83	U	1.74	U	8.69	U	14.5	U	1.74	U	1.87		1.74	U
n-Hexane	16.9		3.70		5.08		22.3		10.3		34.6		94.5		0.705	U	0.818		0.705	U
o-Xylene	2.07	U	5.00		6.43		5.47		2.07	U	10.3		22.8		0.869	U	0.869	U	0.869	U
p/m-Xylene	0.852	U	11.8		15.0		14.3		0.852	U	26.6		69.5		1.74	U	1.74	U	1.74	U
Styrene	1.37	U	1.70	U	2.50	U	2.37	U	1.37	U	4.26	U	7.11	U	0.852	U	1.87		0.852	U
Tertiary butyl Alcohol	6.82		10.6		10.9		4.21	U	4.34		22.5		12.6	U	1.52	U	1.52	U	1.52	U
Tetrachloroethene	1.40		104		90.2		70.5		1.56		148		104		0.264		0.678		0.298	
Tetrahydrofuran	2.06		2.95	U	4.34	U	4.10	U	1.81		7.37	U	12.3	U	1.47	U	1.66		1.47	U
Toluene	7.13		9.08		10.5		12.5		6.19		18.3		32.6		1.81		3.60		1.66	
trans-1,2-Dichloroethene	1.04	U	1.59	U	2.33	U	2.20	U	1.04	U	3.96	U	6.62	U	0.793	U	0.793	U	0.793	U
trans-1,3-Dichloropropene	1.20	U	1.82	U	2.67	U	2.52	U	1.20	U	4.54	U	7.58	U	0.908	U	0.908	U	0.908	U
Trichloroethene	1.20	U	2.15	U	3.16	U	2.99	U	1.20	U	5.37	U	8.97	U	0.107	U	0.269		0.107	U
Trichlorofluoromethane	1.20	U	2.25	U	3.30	U	3.12	U	1.20	U	5.62	U	9.38	U	1.26		1.12	U	1.21	
Vinyl bromide	1.48	U	1.75	U	2.57	U	2.43	U	1.48	U	4.37	U	7.30	U	0.874	U	0.874	U	0.874	U
Vinyl chloride	2.13	U	1.02	U	1.50	U	2.34		2.13	U	2.56	U	12.5		0.051	U	0.057	U	0.051	U
Total BTEX	7.13		33.33		39.05		56.45		6.19		71.87		276.80		2.68		4.33		2.37	

Notes:

$\mu g/m^3$ - Micrograms per cubic meter

NC - No Criteria

U - Non-detect

NYS AGV - New York State Department of Health Aire Guideline Values

*Only the results of indoor air samples were compared to the NYSDOH AGVs

Table 12
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Vapor, Indoor Air, and Ambient Air Analytical Results for Methane

SAMPLE NAME	**TRC-SV-01**		**TRC-SV-02**		**TRC-SV-03**		**TRC-SV-04**		**TRC-SV-05**		**TRC-SV-07**		**TRC-SV-10**		**TRC-SV-11**		**TRC-SV-12**	
LABORATORY ID NO.	L2009476-01		L2010018-02		L2010018-03		L2010018-05		L2010018-01		L2010414-04		L2009712-01		L2010018-04		L2009712-02	
DATE SAMPLE COLLECTED	3/3/2020		3/5/2020		3/5/2020		3/5/2020		3/5/2020		3/6/2020		3/4/2020		3/5/2020		3/4/2020	
MATRIX	SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR	
Fixed Gases (%)	Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)	
Methane	0.156	U	0.222	U	0.169	U	0.156	U	0.167	U	0.169	U	0.182	U	0.232	U	0.147	U

Notes:

% - Percent
U - Non-detect

Table 12
New York City Economic Development Corporation
Bush Terminal South Campus
Brooklyn, New York
CEQR #77SBS011K
Summary of Soil Vapor, Indoor Air, and Ambient Air Analytical Results for Methane

SAMPLE NAME	**TRC-SV-13**		**TRC-SV-14**		**TRC-SV-16**		**TRC-SV-17**		**TRC-SV-20**		**TRC-SV-22**		**TRC-BLDG-57**		**TRC-BLDG-58**		**TRC-AA-01**	
LABORATORY ID NO.	L2010018-06		L2010414-03		L2010462-01		L2009712-03		L2010462-03		L2010462-02		L2010414-01		L2009476-02		L2010414-02	
DATE SAMPLE COLLECTED	3/5/2020		3/6/2020		3/9/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020		3/3/2020		3/6/2020	
MATRIX	SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		INDOOR AIR		INDOOR AIR		AMBIENT AIR	
Fixed Gases (%)	Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)	
Methane	0.147	U	0.149	U	0.156	U	0.167	U	0.178	U	0.178		0.222	U	0.213	U	0.167	U

Notes:

% - Percent

U - Non-detect

Table 1
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

			SAMPLE ID:	**TRC-SB-23 (0-2)**		**TRC-SB-23 (7-9)**		**TRC-SB-24 (0-2)**		**TRC-SB-24 (3-5)**	
			LABORATORY SAMPLE ID:	AD16132-003		AD16132-004		AD16132-001		AD16132-002	
			DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020		3/10/2020		3/10/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1,1-Trichloroethane	0.68	100	500	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,1,2,2-Tetrachloroethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,1,2-Trichloro-1,2,2-trifluoroethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,1,2-Trichloroethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,1-Dichloroethane	0.27	26	240	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,1-Dichloroethene	0.33	100	500	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,2,3-Trichlorobenzene	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,2,4-Trichlorobenzene	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,2,4-Trimethylbenzene	3.6/3.6	52	190	0.0010	U	0.0012	U	0.0013	U	0.0012	U
1,2-Dibromo-3-chloropropane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,2-Dibromoethane	NC	NC	NC	0.0010	U	0.0012	U	0.0013	U	0.0012	U
1,2-Dichlorobenzene	1.1	100	500	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,2-Dichloroethane	0.02	3.1	30	0.0016	U	0.0018	U	0.0020	U	0.0018	U
1,2-Dichloropropane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,3,5-Trimethylbenzene	8.4/8.4	52	190	0.0010	U	0.0012	U	0.0013	U	0.0012	U
1,3-Dichlorobenzene	2.4	49	280	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,4-Dichlorobenzene	1.8	13	130	0.0021	U	0.0024	U	0.0026	U	0.0024	U
1,4-Dioxane	0.1	13	130	0.10	U	0.12	U	0.13	U	0.12	U
2-Butanone	0.12	100	500	0.0021	U	0.0024	U	0.0026	U	0.0024	U
2-Hexanone	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
4-Isopropyltoluene	NC/10	NC	NC	0.0010	U	0.0012	U	0.0013	U	0.0012	U
4-Methyl-2-pentanone	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Acetone	0.05	100	500	0.010	U	0.012	U	0.013	U	0.012	U
Benzene	0.06/0.06	4.8	44	0.0010	U	0.0012	U	0.0013	U	0.0012	U
Bromochloromethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Bromodichloromethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Bromoform	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Bromomethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Carbon disulfide	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Carbon tetrachloride	0.76	2.4	22	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Chlorobenzene	1.1	100	500	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Chloroethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Chloroform	0.37	49	350	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Chloromethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
cis-1,2-Dichloroethene	0.25	100	500	0.0021	U	0.0024	U	0.0026	U	0.0024	U
cis-1,3-Dichloropropene	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U

Table 1
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Volatile Organic Compounds

			SAMPLE ID:	**TRC-SB-23 (0-2)**		**TRC-SB-23 (7-9)**		**TRC-SB-24 (0-2)**		**TRC-SB-24 (3-5)**	
			LABORATORY SAMPLE ID:	AD16132-003		AD16132-004		AD16132-001		AD16132-002	
			DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020		3/10/2020		3/10/2020	
VOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Comissioner's Policy Table 2 and Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Cyclohexane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Dibromochloromethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Dichlorodifluoromethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Ethylbenzene	1/1	41	390	0.0010	U	0.0012	U	0.0013	U	0.0012	U
Isopropylbenzene	NC/2.3	NC	NC	0.0010	U	0.0012	U	0.0013	U	0.0012	U
m&p-Xylenes$^{(1)}$	NC	NC	NC	0.0010	U	0.0012	U	0.0013	U	0.0012	U
Methyl Acetate	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Methylcyclohexane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Methylene chloride	0.05	100	500	0.0022		0.0024	U	0.0026	U	0.0026	
Methyl-t-butyl ether	0.93/0.93	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U
Naphthalene	12/12	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U
n-Butylbenzene	12/12	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U
n-Propylbenzene	3.9/3.9	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U
o-Xylene$^{(1)}$	NC	NC	NC	0.0010	U	0.0012	U	0.0013	U	0.0012	U
sec-Butylbenzene	11/11	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U
Styrene	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
t-Butylbenzene	5.9/5.9	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U
Tetrachloroethene	1.3	19	150	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Toluene	0.7/0.7	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U
trans-1,2-Dichloroethene	0.19	100	500	0.0021	U	0.0024	U	0.0026	U	0.0024	U
trans-1,3-Dichloropropene	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Trichloroethene	0.47	21	200	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Trichlorofluoromethane	NC	NC	NC	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Vinyl chloride	0.02	0.9	13	0.0021	U	0.0024	U	0.0026	U	0.0024	U
Xylenes (Total)	0.26/0.26	100	500	0.0010	U	0.0012	U	0.0013	U	0.0012	U

Notes

(1) - There is no SCO, SSCO, or SCL for m/p-xylene or o-xylene.
The SCO/SCL for total xylenes is 0.26 mg/kg.

SBMT-DUP072419 is a duplicate of sample SBMT-SB-16.
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 2
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:				**TRC-SB-23 (0-2)**		**TRC-SB-23 (7-9)**		**TRC-SB-24 (0-2)**		**TRC-SB-24 (3-5)**	
LABORATORY SAMPLE ID:				AD16132-003		AD16132-004		AD16132-001		AD16132-002	
DATE SAMPLE COLLECTED:				3/10/2020		3/10/2020		3/10/2020		3/10/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,1'-Biphenyl	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
1,2,4,5-Tetrachlorobenzene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
1,4-Dioxane	NC	NC	NC	0.0094	U	0.0091	U	0.0090	U	0.0090	U
2,3,4,6-Tetrachlorophenol	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2,4,5-Trichlorophenol	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2,4,6-Trichlorophenol	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2,4-Dichlorophenol	NC	NC	NC	0.0094	U	0.0091	U	0.0090	U	0.0090	U
2,4-Dimethylphenol	NC	NC	NC	0.0094	U	0.0091	U	0.0090	U	0.0090	U
2,4-Dinitrophenol	NC	NC	NC	0.19	U	0.18	U	0.18	U	0.18	U
2,4-Dinitrotoluene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2,6-Dinitrotoluene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2-Chloronaphthalene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2-Chlorophenol	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2-Methylnaphthalene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2-Methylphenol	0.33	100	500	0.0094	U	0.0091	U	0.0090	U	0.0090	U
2-Nitroaniline	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
2-Nitrophenol	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
3&4-Methylphenol	0.33	100	500	0.0094	U	0.0091	U	0.0090	U	0.0090	U
3,3'-Dichlorobenzidine	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
3-Nitroaniline	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
4,6-Dinitro-2-methylphenol	NC	NC	NC	0.19	U	0.18	U	0.18	U	0.18	U
4-Bromophenyl-phenylether	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
4-Chloro-3-methylphenol	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
4-Chloroaniline	NC	NC	NC	0.0094	U	0.0091	U	0.0090	U	0.0090	U
4-Chlorophenyl-phenylether	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
4-Nitroaniline	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
4-Nitrophenol	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Acenaphthene	20/20	100	500	0.037	U	0.036	U	0.036	U	0.036	U
Acenaphthylene	100/100	100	500	0.037	U	0.036	U	0.036	U	0.036	U
Acetophenone	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Anthracene	100/100	100	500	0.037	U	0.036	U	0.047		0.036	U
Atrazine	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Benzaldehyde	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Benzo[a]anthracene	1/1	1	5.6	0.037	U	0.036	U	0.20		0.074	
Benzo[a]pyrene	1/1	1	1	0.037	U	0.036	U	0.19		0.072	

Table 2
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Semivolatile Organic Compounds

			SAMPLE ID:	**TRC-SB-23 (0-2)**		**TRC-SB-23 (7-9)**		**TRC-SB-24 (0-2)**		**TRC-SB-24 (3-5)**	
			LABORATORY SAMPLE ID:	AD16132-003		AD16132-004		AD16132-001		AD16132-002	
			DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020		3/10/2020		3/10/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375/Commissioner's Policy Table 3 Soil Cleanup Levels	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Benzo[b]fluoranthene	1/1	1	5.6	0.037	U	0.036	U	0.22		0.093	
Benzo[g,h,i]perylene	100/100	100	500	0.037	U	0.036	U	0.11		0.043	
Benzo[k]fluoranthene	0.8/0.8	3.9	56	0.037	U	0.036	U	0.091		0.036	U
bis(2-Chloroethoxy)methane	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
bis(2-Chloroethyl)ether	NC	NC	NC	0.0094	U	0.0091	U	0.0090	U	0.0090	U
bis(2-Chloroisopropyl)ether	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
bis(2-Ethylhexyl)phthalate	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Butylbenzylphthalate	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Caprolactam	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Carbazole	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Chrysene	1/1	3.9	56	0.037	U	0.036	U	0.17		0.070	
Dibenzo[a,h]anthracene	0.33/0.33	0.33	0.56	0.037	U	0.036	U	0.036	U	0.036	U
Dibenzofuran	7	59	350	0.0094	U	0.0091	U	0.0093		0.0090	U
Diethylphthalate	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Dimethylphthalate	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Di-n-butylphthalate	NC	NC	NC	0.0094	U	0.0091	U	0.0090	U	0.0095	
Di-n-octylphthalate	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.034	U
Fluoranthene	100/100	100	500	0.037	U	0.036	U	0.37		0.13	
Fluorene	30/30	100	500	0.037	U	0.036	U	0.036	U	0.036	U
Hexachlorobenzene	0.33	1.2	6	0.037	U	0.036	U	0.036	U	0.036	U
Hexachlorobutadiene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Hexachlorocyclopentadiene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Hexachloroethane	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Indeno[1,2,3-cd]pyrene	0.5/0.5	0.5	5.6	0.037	U	0.036	U	0.096		0.038	
Isophorone	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Naphthalene	12	100	500	0.0094	U	0.0091	U	0.0090	U	0.0090	U
Nitrobenzene	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
N-Nitroso-di-n-propylamine	NC	NC	NC	0.0094	U	0.0091	U	0.0090	U	0.0090	U
N-Nitrosodiphenylamine	NC	NC	NC	0.037	U	0.036	U	0.036	U	0.036	U
Pentachlorophenol	0.8	6.7	6.7	0.19	U	0.18	U	0.18	U	0.18	U
Phenanthrene	100/100	100	500	0.037	U	0.036	U	0.24		0.054	
Phenol	0.33	100	500	0.037	U	0.036	U	0.036	U	0.034	U
Pyrene	100/100	100	500	0.037	U	0.036	U	0.32		0.12	

Notes
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective
Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 3
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Metals

			SAMPLE ID:	TRC-SB-23 (0-2)		TRC-SB-23 (7-9)		TRC-SB-24 (0-2)		TRC-SB-24 (3-5)	
			LABORATORY SAMPLE ID:	AD16132-003		AD16132-004		AD16132-001		AD16132-002	
			DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020		3/10/2020		3/10/2020	
METALS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aluminum	NC	NC	NC	7,600		1,700		5,400		4,600	
Antimony	NC	NC	NC	0.90	U	0.87	U	0.86	U	0.86	U
Arsenic	13	16	16	2.1		1.4		4.7		3.8	
Barium	350	400	400	46		11	U	53		55	
Beryllium	7.2	72	590	0.34		0.22	U	0.22	U	0.22	U
Cadmium	2.5	4.3	9.3	0.45	U	0.43	U	0.43	U	0.43	U
Calcium	NC	NC	NC	1,100	U	1,100	U	1,900		1,100	U
Chromium	30	180	1,500	16		7.4		14		11	
Cobalt	NC	NC	NC	8.8		6.3		5.6		6.8	
Copper	50	270	270	12		5.4	U	27		17	
Iron	NC	NC	NC	16,000		7,300		12,000		11,000	
Lead	63	400	1,000	5.7		6.2		24		14	
Magnesium	NC	NC	NC	2,700		14,000		2,300		2,000	
Manganese	1,600	2,000	10,000	330		89		270		340	
Mercury	0.18	0.81	2.8	0.094	U	0.091	U	0.090	U	0.090	U
Nickel	30	310	310	25		**130**		17		15	
Potassium	NC	NC	NC	1,500		540	U	950		940	
Selenium	3.9	180	1,500	2.2	U	2.2	U	2.2	U	2.2	U
Silver	2	180	1,500	0.22	U	0.22	U	0.22	U	0.22	U
Sodium	NC	NC	NC	280	U	270	U	270	U	270	U
Thallium	NC	NC	NC	0.45	U	0.43	U	0.43	U	0.43	U
Vanadium	NC	NC	NC	24		11		21		17	
Zinc	109	10,000	10,000	37		28		**260**		**110**	

Notes
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect
J - Estimated value

Table 4
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Polychlorinated Biphenyls

			SAMPLE ID:	**TRC-SB-23 (0-2)**		**TRC-SB-23 (7-9)**		**TRC-SB-24 (0-2)**		**TRC-SB-24 (3-5)**	
			LABORATORY SAMPLE ID:	AD16132-003		AD16132-004		AD16132-001		AD16132-002	
			DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020		3/10/2020		3/10/2020	
POLYCHLORINATED BIPHENYLS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
Aroclor-1016	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1221	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1232	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1242	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1248	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1254	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1260	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1262	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor-1268	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
Aroclor (Total)	0.1	1	1	0.028	U	0.027	U	0.027	U	0.027	U

Notes
mg/kg - milligrams per kilogram
NC - No criterion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

TICs - Tentatively Identified Compounds
U - Non-detect
J - Estimated value

Table 5
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Pesticides

SAMPLE ID:				**TRC-SB-23 (0-2)**		**TRC-SB-23 (7-9)**		**TRC-SB-24 (0-2)**		**TRC-SB-24 (3-5)**	
LABORATORY SAMPLE ID:				AD16132-003		AD16132-004		AD16132-001		AD16132-002	
DATE SAMPLE COLLECTED:				3/10/2020		3/10/2020		3/10/2020		3/10/2020	
PESTICIDES (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
a-Chlordane	0.094	4.2	24	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Aldrin	0.005	0.097	0.68	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Alpha-BHC	0.02	0.48	3.4	0.0011	U	0.0011	U	0.0011	U	0.0011	U
beta-BHC	0.036	0.36	3	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Chlordane (Total)	NC	NC	NC	0.0056	U	0.0054	U	0.0054	U	0.0054	U
delta-BHC	0.04	100	500	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Dieldrin	0.005	0.2	1.4	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Endosulfan I	2.4	24	200	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Endosulfan II	2.4	24	200	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Endosulfan Sulfate	2.4	24	200	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Endrin	0.014	11	89	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Endrin Aldehyde	NC	NC	NC	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Endrin Ketone	NC	NC	NC	0.0056	U	0.0054	U	0.0054	U	0.0054	U
gamma-BHC	0.1	1.3	9.2	0.0011	U	0.0011	U	0.0011	U	0.0011	U
Heptachlor	0.042	2.1	15	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Heptachlor Epoxide	NC	NC	NC	0.0056	U	0.0054	U	0.0054	U	0.0054	U
Methoxychlor	NC	NC	NC	0.0056	U	0.0054	U	0.0054	U	0.0054	U
p,p'-DDD	0.0033	13	92	0.0028	U	0.0027	U	0.0027	U	0.0027	U
p,p'-DDE	0.0033	8.9	62	0.0028	U	0.0027	U	0.0027	U	0.0027	U
p,p'-DDT	0.0033	7.9	47	0.0028	U	0.0027	U	0.0027	U	0.0027	U
Toxaphene	NC	NC	NC	0.028	U	0.027	U	0.027	U	0.027	U
y-Chlordane	NC	NC	NC	0.0056	U	0.0054	U	0.0054	U	0.0054	U

Notes

mg/kg - milligrams per kilogram

NC - No criterion

SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.

U - Non-detect

J - Estimated value

Table 6
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Emerging Contaminants and Herbicides

SAMPLE ID:				TRC-SB-02 (4-6)		TRC-SB-03 (5-7)		TRC-SB-05 (5-7)		TRC-SB-06 (6-8)		TRC-SB-07 (4-6)		TRC-SB-10 (4-6)		TRC-SB-11 (4-6)	
LABORATORY SAMPLE ID:				L2010026-01		L2010026-02		L2009715-03		L2010261-01		L2010261-03		L2009715-04		L2010026-03	
DATE SAMPLE COLLECTED:				3/5/2020		3/5/2020		3/4/2020		3/6/2020		3/6/2020		3/4/2020		3/5/2020	
PERFLUORINATED ALKYL ACIDS (ppt)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)	
Perfluorobutanoic Acid (PFBA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	50	J
Perfluoropentanoic Acid (PFPeA)	NC	NC	NC	63	J	58	J	52	J	1,030	U	1,000	U	956	U	143	J
Perfluorobutanesulfonic Acid (PFBS)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluorohexanoic Acid (PFHxA)	NC	NC	NC	98	J	67	J	67	J	1,030	U	1,000	U	956	J	150	J
Perfluoroheptanoic Acid (PFHpA)	NC	NC	NC	82	J	1,080	U	1,090	U	1,030	U	1,000	U	956	U	107	J
Perfluorohexanesulfonic Acid (PFHxS)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluorooctanoic Acid (PFOA)	NC	NC	NC	724	J	455	J	1,090	U	70	J	90	J	1,300		792	J
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluoroheptanesulfonic Acid (PFHpS)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluorononanoic Acid (PFNA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	142	J
Perfluorooctanesulfonic Acid (PFOS)	NC	NC	NC	720	J	1,080	U	1,090	U	1,030	U	198	J	235	J	1,810	
Perfluorodecanoic Acid (PFDA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	291	J
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluoroundecanoic Acid (PFUnA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	95	J
Perfluorodecanesulfonic Acid (PFDS)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluorooctanesulfonamide (FOSA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluorododecanoic Acid (PFDoA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	94	J
Perfluorotridecanoic Acid (PFTrDA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Perfluorotetradecanoic Acid (PFTA)	NC	NC	NC	1,240	U	1,080	U	1,090	U	1,030	U	1,000	U	956	U	1,020	U
Total PFOA/PFOS	NC	NC	NC	1,440	J	455	J	1,090	U	70	J	288	J	1,540	J	2,600	J
ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,4-Dioxane	0.1	13	130	0.031	U	0.028	U	0.03	U	0.027	U	0.026	U	0.026	U	0.027	U
HERBICIDES (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
2,4-D	NC	NC	NC	0.211	U	0.188	U	0.202	U	0.181	U	0.174	U	0.172	U	0.18	U
2,4,5-T	NC	NC	NC	0.211	U	0.188	U	0.202	U	0.181	U	0.174	U	0.172	U	0.18	U
2,4,5-TP (Silvex)	3.8	100	500	0.211	U	0.188	U	0.202	U	0.181	U	0.174	U	0.172	U	0.18	U

Notes
mg/kg - milligrams per kilogram
NC - No criterion
ppt - parts per trillion
SCO - Soil Cleanup Objective

Shading and bolding indicates results above comparison criteria.

Color representing least stringent criteria exceeded is shown unless otherwise noted.
U - Non-detect
J - Estimated value

Table 6
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Sampling Analytical Results for Emerging Contaminants and Herbicides

SAMPLE ID:				TRC-SB-12 (3-5)		TRC-SB-13 (6-8)		TRC-SB-14 (4-6)		TRC-SB-15 (9-11)		TRC-SB-16 (8-10)		TRC-SB-19 (7-9)		TRC-SB-21 (6-8)		TRC-SB-22 (6-8)		TRC-DUP-02	
LABORATORY SAMPLE ID:				L2009715-01		L2010026-04		L2010261-04		L2010261-05		L2010489-01		L2009715-02		L2010489-03		L2010489-02		L2010261-02	
DATE SAMPLE COLLECTED:				3/4/2020		3/5/2020		3/6/2020		3/6/2020		3/9/2020		3/4/2020		3/9/2020		3/9/2020		3/6/2020	
PERFLUORINATED ALKYL ACIDS (ppt)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)		Result (ppt)	
Perfluorobutanoic Acid (PFBA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluoropentanoic Acid (PFPeA)	NC	NC	NC	1,020	U	56	J	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorobutanesulfonic Acid (PFBS)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorohexanoic Acid (PFHxA)	NC	NC	NC	1,020	U	84	J	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluoroheptanoic Acid (PFHpA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorohexanesulfonic Acid (PFHxS)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorooctanoic Acid (PFOA)	NC	NC	NC	84	J	795	J	55	J	83	J	116	J	113	J	627	J	1,070	U	158	J
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluoroheptanesulfonic Acid (PFHpS)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorononanoic Acid (PFNA)	NC	NC	NC	92	J	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorooctanesulfonic Acid (PFOS)	NC	NC	NC	453	J	984	U	38.3	J	177	J	166	J	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorodecanoic Acid (PFDA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluoroundecanoic Acid (PFUnA)	NC	NC	NC	1,020	U	984	U	120	J	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorodecanesulfonic Acid (PFDS)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorooctanesulfonamide (FOSA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorododecanoic Acid (PFDoA)	NC	NC	NC	1,020	U	984	U	107	J	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorotridecanoic Acid (PFTrDA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Perfluorotetradecanoic Acid (PFTA)	NC	NC	NC	1,020	U	984	U	1,110	U	993	U	1,000	U	1,060	U	1,080	U	1,070	U	1,020	U
Total PFOA/PFOS	NC	NC	NC	537	J	795	J	438	J	260	J	282	J	113	J	627	J	1,070	U	158	J
ORGANIC COMPOUNDS (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
1,4-Dioxane	0.1	13	130	0.026	U	0.027	U	0.028	U	0.026	U	0.026	U	0.028	U	0.029	U	0.028	U	0.026	U
HERBICIDES (mg/kg)	Unrestricted Use SCOs per 6 NYCRR Part 375	Restricted Residential Use SCOs per 6 NYCRR Part 375	Commercial Use SCOs per 6 NYCRR Part 375	Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)		Result (mg/kg)	
2,4-D	NC	NC	NC	0.171	U	0.182	U	0.184	U	0.175	U	0.175	U	0.187	U	0.195	U	0.19	U	0.173	U
2,4,5-T	NC	NC	NC	0.171	U	0.182	U	0.184	U	0.175	U	0.175	U	0.187	U	0.195	U	0.19	U	0.173	U
2,4,5-TP (Silvex)	3.8	100	500	0.171	U	0.182	U	0.184	U	0.175	U	0.175	U	0.187	U	0.195	U	0.19	U	0.173	U

Notes
mg/kg - milligrams per kilogram
NC - No criterion
ppt - parts per trillion
SCO - Soil Cleanup Objective

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U - Non-detect
J - Estimated value

Table 7
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Volatile Organic Compounds

SAMPLE ID:		**TRC-GW-23**		**TRC-GW-24**	
LABORATORY SAMPLE ID:		AD16133-001		AD16133-003	
DATE SAMPLE COLLECTED:		3/10/2020		3/10/2020	
VOLATILE ORGANIC COMPOUNDS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
1,1,1-Trichloroethane	5	1.0	U	1.0	U
1,1,2,2-Tetrachloroethane	5	1.0	U	1.0	U
1,1,2-Trichloro-1,2,2-trifluoroethane	5	1.0	U	1.0	U
1,1,2-Trichloroethane	1	1.0	U	1.0	U
1,1-Dichloroethane	5	1.0	U	1.0	U
1,1-Dichloroethene	5	1.0	U	1.0	U
1,2,3-Trichlorobenzene	5	1.0	U	1.0	U
1,2,4-Trichlorobenzene	5	1.0	U	1.0	U
1,2,4-Trimethylbenzene	5	1.0	U	1.0	U
1,2-Dibromo-3-chloropropane	0.04	1.0	U	1.0	U
1,2-Dibromoethane	0.0006	1.0	U	1.0	U
1,2-Dichlorobenzene	3	1.0	U	1.0	U
1,2-Dichloroethane	0.6	0.50	U	0.50	U
1,2-Dichloropropane	1	1.0	U	1.0	U
1,3,5-Trimethylbenzene	5	1.0	U	1.0	U
1,3-Dichlorobenzene	3	1.0	U	1.0	U
1,4-Dichlorobenzene	3	1.0	U	1.0	U
1,4-Dioxane	NC	50	U	50	U
2-Butanone	50	1.0	U	1.0	U
2-Hexanone	50	1.0	U	1.0	U
4-Isopropyltoluene	5	1.0	U	1.0	U
4-Methyl-2-pentanone	50	1.0	U	1.0	U
Acetone	50	5.0	U	5.0	U
Benzene	1	0.50	U	0.50	U
Bromochloromethane	5	1.0	U	1.0	U
Bromodichloromethane	50	1.0	U	1.0	U
Bromoform	50	1.0	U	1.0	U
Bromomethane	5	1.0	U	1.0	U
Carbon disulfide	60	1.0	U	1.0	U
Carbon tetrachloride	5	1.0	U	1.0	U
Chlorobenzene	5	1.0	U	1.0	U
Chloroethane	5	1.0	U	1.0	U
Chloroform	7	1.0	U	1.0	U
Chloromethane	5	1.0	U	1.0	U
cis-1,2-Dichloroethene	5	1.0	U	1.0	U
cis-1,3-Dichloropropene	0.4$^{(2)}$	1.0	U	1.0	U

Table 7
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Volatile Organic Compounds

SAMPLE ID:		**TRC-GW-23**		**TRC-GW-24**	
LABORATORY SAMPLE ID:		AD16133-001		AD16133-003	
DATE SAMPLE COLLECTED:		3/10/2020		3/10/2020	
VOLATILE ORGANIC COMPOUNDS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
Cyclohexane	NC	5.2		1.0	U
Dibromochloromethane	50	1.0	U	1.0	U
Dichlorodifluoromethane	5	1.0	U	1.0	U
Ethylbenzene	5	1.0	U	1.0	U
Isopropylbenzene	5	1.0	U	1.0	U
m&p-Xylenes	5	1.0	U	1.0	U
Methyl Acetate	NC	1.0	U	1.0	U
Methylcyclohexane	NC	1.0	U	1.0	U
Methylene chloride	5	1.0	U	1.0	U
Methyl-t-butyl ether	10	0.50	U	0.50	U
Naphthalene	10	1.0	U	1.0	U
n-Butylbenzene	5	1.0	U	1.0	U
n-Propylbenzene	5	1.0	U	1.0	U
o-Xylene	NC	1.0	U	1.0	U
sec-Butylbenzene	5	1.0	U	1.0	U
Styrene	5	1.0	U	1.0	U
t-Butylbenzene	5	1.0	U	1.0	U
Tetrachloroethene	5	1.0	U	1.0	U
Toluene	5	1.0	U	1.0	U
trans-1,2-Dichloroethene	5	1.0	U	1.0	U
trans-1,3-Dichloropropene	0.4(2)	1.0	U	1.0	U
Trichloroethene	5	1.0	U	1.0	U
Trichlorofluoromethane	5	1.0	U	1.0	U
Vinyl chloride	2	1.0	U	1.0	U
Xylenes (Total)	5(1)	1.0	U	1.0	U

Notes

(1) - There is no GA value for total xylenes. The standards for o-xylene, m-xylene, and p-xylene is 5 µg/L.

(2) - 0.4 µg/L applies to the sum of cis- and trans-1,3-dichloropropene.

µg/L - micrograms per liter

NC - No criterion

U - Non-detect

Shaded and **bold** results exceed the corresponding Class GA Value.

Table 8
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Semivolatile Organic Compounds

	SAMPLE ID:	**TRC-GW-23**		**TRC-GW-24**	
	LABORATORY SAMPLE ID:	AD16133-001		AD16133-003	
	DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
1,1'-Biphenyl	5	2.1	U	2.0	U
1,2,4,5-Tetrachlorobenzene	5	2.1	U	2.0	U
2,3,4,6-Tetrachlorophenol	NC	2.1	U	2.0	U
2,4,5-Trichlorophenol	NC	2.1	U	2.0	U
2,4,6-Trichlorophenol	NC	2.1	U	2.0	U
2,4-Dichlorophenol	5	0.53	U	0.50	U
2,4-Dimethylphenol	50	0.53	U	0.50	U
2,4-Dinitrophenol	10	11	U	10	U
2,4-Dinitrotoluene	5	2.1	U	2.0	U
2,6-Dinitrotoluene	5	2.1	U	2.0	U
2-Chloronaphthalene	10	2.1	U	2.0	U
2-Chlorophenol	NC	2.1	U	2.0	U
2-Methylnaphthalene	NC	2.1	U	2.0	U
2-Methylphenol	NC	0.53	U	0.50	U
2-Nitroaniline	5	2.1	U	2.0	U
2-Nitrophenol	NC	2.1	U	2.0	U
3&4-Methylphenol	NC	0.53	U	0.50	U
3,3'-Dichlorobenzidine	5	2.1	U	2.0	U
3-Nitroaniline	5	2.1	U	2.0	U
4,6-Dinitro-2-methylphenol	NC	11	U	10	U
4-Bromophenyl-phenylether	NC	2.1	U	2.0	U
4-Chloro-3-methylphenol	NC	2.1	U	2.0	U
4-Chloroaniline	5	0.53	U	0.50	U
4-Chlorophenyl-phenylether	NC	2.1	U	2.0	U
4-Nitroaniline	5	2.1	U	2.0	U
4-Nitrophenol	NC	2.1	U	2.0	U
Acenaphthene	20	2.1	U	2.0	U
Acenaphthylene	NC	2.1	U	2.0	U
Acetophenone	NC	2.1	U	2.0	U
Anthracene	50	2.1	U	2.0	U
Atrazine	7.5	2.1	U	2.0	U
Benzaldehyde	NC	2.1	U	2.0	U
Benzo[a]anthracene	0.002	2.1	U	2.0	U
Benzo[a]pyrene	ND*	2.1	U	2.0	U
Benzo[b]fluoranthene	0.002	2.1	U	2.0	U
Benzo[g,h,i]perylene	NC	2.1	U	2.0	U
Benzo[k]fluoranthene	0.002	2.1	U	2.0	U
bis(2-Chloroethoxy)methane	5	2.1	U	2.0	U

Table 8
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Semivolatile Organic Compounds

SAMPLE ID:		**TRC-GW-23**		**TRC-GW-24**	
LABORATORY SAMPLE ID:		AD16133-001		AD16133-003	
DATE SAMPLE COLLECTED:		3/10/2020		3/10/2020	
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
bis(2-Chloroethyl)ether	1	0.53	U	0.50	U
bis(2-Chloroisopropyl)ether	5	2.1	U	2.0	U
bis(2-Ethylhexyl)phthalate	5	2.1	U	2.0	U
Butylbenzylphthalate	50	2.1	U	2.0	U
Caprolactam	NC	2.1	U	2.0	U
Carbazole	NC	2.1	U	2.0	U
Chrysene	0.002	2.1	U	2.0	U
Dibenzo[a,h]anthracene	NC	2.1	U	2.0	U
Dibenzofuran	NC	0.53	U	0.50	U
Diethylphthalate	50	2.1	U	2.0	U
Dimethylphthalate	50	2.1	U	2.0	U
Di-n-butylphthalate	50	0.53	U	0.50	U
Di-n-octylphthalate	NC	2.1	U	2.0	U
Fluoranthene	50	2.1	U	2.0	U
Fluorene	50	2.1	U	2.0	U
Hexachlorobenzene	0.04	2.1	U	2.0	U
Hexachlorobutadiene	0.5	2.1	U	2.0	U
Hexachlorocyclopentadiene	5	2.1	U	2.0	U
Hexachloroethane	5	2.1	U	2.0	U
Indeno[1,2,3-cd]pyrene	0.002	2.1	U	2.0	U
Isophorone	50	2.1	U	2.0	U
Naphthalene	10	0.53	U	0.50	U
Nitrobenzene	0.4	2.1	U	2.0	U
N-Nitroso-di-n-propylamine	NC	0.53	U	0.50	U
N-Nitrosodiphenylamine	50	2.1	U	2.0	U
Pentachlorophenol	1	11	U	10	U
Phenanthrene	50	2.1	U	2.0	U
Phenol	1	2.1	U	2.0	U
Pyrene	50	2.1	U	2.0	U

Notes
µg/L - micrograms per liter
NC - No criterion
ND* - any detection considered
above the Class GA Standard
U - Non-detect
Shaded and **bold** results exceed the corresponding Class GA Value.

Table 9
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Metals

SAMPLE ID:		**TRC-GW-23**		**TRC-GW-24**	
LABORATORY SAMPLE ID:		AD16133-001		AD16133-003	
DATE SAMPLE COLLECTED:		3/10/2020		3/10/2020	
METALS (UNFILTERED) (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
Aluminum	2,000	200	U	**32,000**	
Antimony	3	3.0	U	**4.1**	
Arsenic	25	2.0	U	**33**	
Barium	1,000	50	U	230	
Beryllium	3	1.0	U	1.5	
Cadmium	5	2.0	U	2.0	U
Calcium	NC	48,000		86,000	
Chromium	50	50	U	**67**	
Cobalt	NC	2.0	U	21	
Copper	200	50	U	**250**	
Iron	300	300	U	**54,000**	
Lead	25	3.0	U	**450**	
Magnesium	35,000	7,200		28,000	
Manganese	300	**350**		**1,600**	
Mercury	0.7	0.50	U	0.50	U
Nickel	100	50	U	84	
Potassium	NC	8,400		8,300	
Selenium	10	10	U	10	U
Silver	50	20	U	20	U
Sodium	20,000	20,000		**41,000**	
Thallium	0.5	2.0	U	2.0	U
Vanadium	NC	50	U	76	
Zinc	2,000	50	U	850	

SAMPLE ID:		**TRC-GW-23**		**TRC-GW-24**	
LABORATORY SAMPLE ID:		AD16133-002		AD16133-004	
DATE SAMPLE COLLECTED:		3/10/2020		3/10/2020	
METALS (FILTERED) (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
Aluminum	2,000	200	U	200	U
Antimony	3	3.0	U	3.0	U
Arsenic	25	2.0	U	3.2	
Barium	1,000	50	U	50	U
Beryllium	3	1.0	U	1.0	U
Cadmium	5	2.0	U	2.0	U
Calcium	NC	49,000		71,000	
Chromium	50	50	U	50	U
Cobalt	NC	2.0	U	2.0	
Copper	200	50	U	50	U
Iron	300	300	U	**4,400**	
Lead	25	3.0	U	3.0	U
Magnesium	35,000	7,600		17,000	
Manganese	300	**370**		**840**	
Mercury	0.7	0.50	U	0.50	U
Nickel	100	50	U	50	U
Potassium	NC	8,600		5,000	U
Selenium	10	10	U	10	U
Silver	50	20	U	20	U
Sodium	20,000	20,000		**39,000**	
Thallium	0.5	2.0	U	2.0	U
Vanadium	NC	50	U	50	U
Zinc	2,000	50	U	50	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results exceed corresponding Class GA Value.

Table 10
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Polychlorinated Biphenyls

	SAMPLE ID:	TRC-GW-23		TRC-GW-24	
	LABORATORY SAMPLE ID:	AD16133-001		AD16133-003	
	DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020	
POLYCHLORINATED BIPHENYLS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
PCB-1016 (Aroclor 1016)	NC	0.25	U	0.26	U
PCB-1221 (Aroclor 1221)	NC	0.25	U	0.26	U
PCB-1232 (Aroclor 1232)	NC	0.25	U	0.26	U
PCB-1242 (Aroclor 1242)	NC	0.25	U	0.26	U
PCB-1248 (Aroclor 1248)	NC	0.25	U	0.26	U
PCB-1254 (Aroclor 1254)	NC	0.25	U	0.26	U
PCB-1260 (Aroclor 1260)	NC	0.25	U	0.81	
PCB-1262 (Aroclor 1262)	NC	0.25	U	0.26	U
PCB-1268 (Aroclor 1268)	NC	0.25	U	0.26	U
Total PCBs	0.09	0.25	U	**0.81**	

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
Shaded and **bold** results exceed corresponding Class GA Value.

Table 11
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Pesticides

	SAMPLE ID:	TRC-GW-23		TRC-GW-24	
	LABORATORY SAMPLE ID:	AD16133-001		AD16133-003	
	DATE SAMPLE COLLECTED:	3/10/2020		3/10/2020	
PESTICIDES (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)	
a-Chlordane	0.05	0.010	U	0.011	U
Aldrin	ND	0.010	U	0.011	U
Alpha-BHC	0.01	0.010	U	0.011	U
beta-BHC	0.04	0.010	U	0.011	U
Chlordane (Total)	0.05	0.010	U	0.011	U
delta-BHC	0.04	0.010	U	0.011	U
Dieldrin	0.004	0.010	U	0.011	U
Endosulfan I	NC	0.010	U	0.011	U
Endosulfan II	NC	0.010	U	0.011	U
Endosulfan Sulfate	NC	0.010	U	0.011	U
Endrin	ND*	0.010	U	0.011	U
Endrin Aldehyde	5	0.010	U	0.011	U
Endrin Ketone	5	0.010	U	0.011	U
gamma-BHC	0.05	0.010	U	0.011	U
Heptachlor	0.04	0.010	U	0.011	U
Heptachlor Epoxide	0.03	0.010	U	0.011	U
Methoxychlor	35	0.010	U	0.011	U
p,p'-DDD	0.3	0.010	U	0.011	U
p,p'-DDE	0.2	0.010	U	0.011	U
p,p'-DDT	0.2	0.010	U	0.011	U
Toxaphene	0.06	0.25	U	0.26	U
y-Chlordane	0.05	0.010	U	0.011	U

Notes
µg/L - micrograms per liter
NC - No criterion
U - Non-detect
ND* - any detection considered
above the Class GA Standard
Shaded and **bold** results exceed corresponding Class GA Value.

Table 12
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Groundwater Sampling Analytical Results for Emerging Contaminants and Herbicides

	SAMPLE ID:	TRC-GW-02		TRC-GW-07		TRC-GW-14		TRC-GW-16		TRC-GW-17		TRC-DUP-01	
	LABORATORY SAMPLE ID:	L2010026-05		L2010261-07		L2010261-06		L2010489-04		L2009715-05		L2010261-08	
	DATE SAMPLE COLLECTED:	3/5/2020		3/6/2020		3/6/2020		3/9/2020		3/4/2020		3/6/2020	
PERFLUORINATED ALKYL ACID (ng/L)	Class GA Value (ng/L)	Results (ng/L)		Results (ng/L)		Results (ng/L)		Results (ng/L)		Results (ng/L)		Results (ng/L)	
Perfluorobutanoic Acid (PFBA)	NC	8.77		9.91		11.0		3.17		7.22		13.6	
Perfluoropentanoic Acid (PFPeA)	NC	10.3		10.3		9.80		3.85		15.8		11.8	
Perfluorobutanesulfonic Acid (PFBS)	NC	3.12		1.81	J	1.98	U	2.52		2.02		1.52	J
Perfluorohexanoic Acid (PFHxA)	NC	11.2		14.7		12.6		3.50		13.8		13.9	
Perfluoroheptanoic Acid (PFHpA)	NC	13.20		27.2		24.7		5.50		12.4		27.1	
Perfluorohexanesulfonic Acid (PFHxS)	NC	3.54		4.39		1.17	J	1.40	J	5.01		2.43	U
Perfluorooctanoic Acid (PFOA)	NC	113		201		89.9		61.30		140		102	
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluoroheptanesulfonic Acid (PFHpS)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluorononanoic Acid (PFNA)	NC	10.6		5.76		1.98	U	5		1.26	J	2.43	U
Perfluorooctanesulfonic Acid (PFOS)	NC	64.4		23.8		2.01		23		9.52		5.58	
Perfluorodecanoic Acid (PFDA)	NC	1.26	J	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluoroundecanoic Acid (PFUnA)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluorodecanesulfonic Acid (PFDS)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluorooctanesulfonamide (FOSA)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	NC	1.86	U	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluorododecanoic Acid (PFDoA)	NC	0.643	J	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluorotridecanoic Acid (PFTrDA)	NC	0.442	J	2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Perfluorotetradecanoic Acid (PFTA)	NC	3.23		2.02	U	1.98	U	1.98	U	1.94	U	2.43	U
Total PFOA/PFOS	NC	177		225		91.9		84.3		150		108	
ORGANIC COMPOUNDS (µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
1,4-Dioxane	NC	0.15	U	0.163	U	0.0804	J	0.15	U	0.257		0.0816	J
HERBICIDE(µg/L)	Class GA Value (µg/L)	Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)		Results (µg/L)	
2,4-D	50	10	U	10	U	10	U	10	U	10	U	10	U
2,4,5-T	35	2	U	2	U	2	U	2	U	2	U	2	U
2,4,5-TP (Silvex)	0.26	2	U	2	U	2	U	2	U	2	U	2	U

Notes

ng/L - nanograms per liter

µg/L - micrograms per liter

NC - No criterion

U - Non-detect

Shaded and **bold** results exceed corresponding Class GA Value.

Table 13
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Vapor and Indoor Air Analytical Results for Select Volatile Organic Compounds

SAMPLE NAME		**TRC-SV-23**		**TRC-SV-24**		**TRC-SV-25**		**TRC-SV-26**		**TRC-SV-27**		**TRC-SV-28**		**TRC-SV-29**		**TRC-SV-30**		**TRC-BLDG-57CS**		**TRC-BLDG-58CS**	
LABORATORY ID NO.		L2010690-03		L2010690-05		L2010690-01		L2010881-01		L2010690-02		L2010881-02		L2010881-03		L2010690-04		L2010881-04		L2010881-05	
DATE SAMPLE COLLECTED		3/10/2020		3/10/2020		3/10/2020		3/11/2020		3/10/2020		3/11/2020		3/11/2020		3/10/2020		3/11/2020		3/11/2020	
MATRIX		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		INDOOR AIR		INDOOR AIR	
VOLATILE ORGANIC COMPOUND (µg/m^3)	NYSDOH AGV	Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)		Result (µg/m^3)	
1,1,1-Trichloroethane	NC	2.18	U	6.82	U	39.1		7.58		15.7		3.41	U	2.18	U	5.46	U	0.109	U	0.109	U
1,1,2,2-Tetrachloroethane	NC	2.75	U	8.58	U	3.43	U	4.58	U	1.37	U	4.29	U	2.75	U	6.87	U	1.37	U	1.37	U
1,1,2-Trichloroethane	NC	2.18	U	6.82	U	2.73	U	3.64	U	1.09	U	3.41	U	2.18	U	5.46	U	1.09	U	1.09	U
1,1-Dichloroethane	NC	1.62	U	5.06	U	10.4		2.7	U	18.3		2.53	U	1.62	U	4.05	U	0.809	U	0.809	U
1,1-Dichloroethene	NC	1.59	U	4.96	U	61.9		2.64	U	31.6		2.48	U	1.59	U	3.96	U	0.079	U	0.079	U
1,2,4-Trichlorobenzene	NC	2.97	U	9.28	U	3.71	U	4.95	U	1.48	U	4.64	U	2.97	U	7.42	U	1.48	U	1.48	U
1,2,4-Trimethylbenzene	NC	10.9		12.1		10.9		8.6		9.93		6.49		7.52		10.8		0.983	U	0.983	U
1,2-Dibromoethane	NC	3.07	U	9.61	U	3.84	U	5.13	U	1.54	U	4.8	U	3.1	U	7.69	U	1.54	U	1.54	U
1,2-Dichlorobenzene	NC	2.40	U	7.52	U	3.01	U	4.01	U	1.20	U	3.76	U	2.4	U	6.01	U	1.20	U	1.20	U
1,2-Dichloroethane	NC	1.620	U	5.060	U	2.02	U	2.70	U	0.809	U	2.53	U	1.62	U	4.05	U	1		0.81	U
1,2-Dichloropropane	NC	1.850	U	5.780	U	2.31	U	3.08	U	0.924	U	2.89	U	1.85	U	4.62	U	0.92	U	0.92	U
1,3,5-Trimethylbenzene	NC	3.21		6.15	U	3.02		3.28	U	2.6		3.07	U	1.97	U	4.92	U	0.983	U	0.983	U
1,3-Butadiene	NC	1.5		2.77	U	1.11	U	1.48	U	0.442	U	1.38	U	0.885	U	4.98		0.442	U	0.442	U
1,3-Dichlorobenzene	NC	2.40	U	7.52	U	3.01	U	4.01	U	1.20	U	3.76	U	2.4	U	6.01	U	1.2	U	1.20	U
1,4-Dichlorobenzene	NC	2.40	U	7.52	U	3.01	U	4.01	U	1.20	U	3.76	U	2.4	U	6.01	U	1.20	U	1.20	U
1,4-Dioxane	NC	1.44	U	4.5	U	1.8	U	2.40	U	0.721	U	2.25	U	1.44	U	3.6	U	0.721	U	0.721	U
2,2,4-Trimethylpentane	NC	1.87	U	5.84	U	2.34	U	3.12	U	0.934	U	2.92	U	1.87	U	4.67	U	0.93	U	0.93	U
2-Butanone	NC	95.3		248		99.7		188		56.6		152		107		196		1.47	U	1.47	U
2-Hexanone	NC	37.70		85.7		34.1		50.8		21.40		47.5		51.6		43.40		0.82	U	0.8	U
3-Chloropropene	NC	1.25	U	3.91	U	1.57	U	2.09	U	0.626	U	1.96	U	1	U	3.13	U	0.626	U	0.626	U
4-Ethyltoluene	NC	2.75		6.15	U	3.28		3.28	U	2.11		3.07	U	1.97	U	4.92	U	0.983	U	0.983	U
4-Methyl-2-pentanone	NC	4.1	U	12.8	U	5.12	U	6.84	U	2.05	U	6.39	U	4.1	U	10.2	U	2.05	U	2.05	U
Acetone	NC	1,230		2,920		1,380		1,810		744		1,590		931		2,420		2.38	U	29	
Benzene	NC	1.42		3.99	U	2.03		6.64		0.639	U	2.00	U	2.03		3.19	U	0.64	U	0.64	U
Benzyl chloride	NC	2.07	U	6.47	U	2.59	U	3.45	U	1.04	U	3.24	U	2.07	U	5.18	U	1.04	U	1.04	U
Bromodichloromethane	NC	2.68	U	8.37	U	3.35	U	4.47	U	1.34	U	4.19	U	2.68	U	6.7	U	1.34	U	1.34	U
Bromoform	NC	4.14	U	12.9	U	5.17	U	6.9	U	2.07	U	6.46	U	4.14	U	10.3	U	2.07	U	2.07	U
Bromomethane	NC	1.55	U	4.85	U	1.94	U	2.59	U	0.777	U	2.43	U	1.55	U	3.88	U	0.777	U	0.777	U
Carbon disulfide	NC	1.97		3.89	U	1.56	U	5.67		0.623	U	1.95	U	1.25	U	3.11	U	0.623	U	0.623	U
Carbon tetrachloride	NC	2.52	U	7.86	U	3.15	U	41.6		1.26	U	3.93	U	2.52	U	6.29	U	0.44		0.409	
Chlorobenzene	NC	1.84	U	5.76	U	2.3	U	3.07	U	0.921	U	2.88	U	1.84	U	4.61	U	0.921	U	0.921	U
Chloroethane	NC	1.06	U	3.3	U	1.32	U	1.76	U	0.528	U	1.65	U	1.06	U	2.64	U	0.528	U	0.528	U

Table 13
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Vapor and Indoor Air Analytical Results for Select Volatile Organic Compounds

SAMPLE NAME		**TRC-SV-23**		**TRC-SV-24**		**TRC-SV-25**		**TRC-SV-26**		**TRC-SV-27**		**TRC-SV-28**		**TRC-SV-29**		**TRC-SV-30**		**TRC-BLDG-57CS**		**TRC-BLDG-58CS**	
LABORATORY ID NO.		L2010690-03		L2010690-05		L2010690-01		L2010881-01		L2010690-02		L2010881-02		L2010881-03		L2010690-04		L2010881-04		L2010881-05	
DATE SAMPLE COLLECTED		3/10/2020		3/10/2020		3/10/2020		3/11/2020		3/10/2020		3/11/2020		3/11/2020		3/10/2020		3/11/2020		3/11/2020	
MATRIX		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		INDOOR AIR		INDOOR AIR	
VOLATILE ORGANIC COMPOUND (µg/m³)	NYSDOH AGV	Result (µg/m³)		Result (µg/m³)		Result (µg/m³)		Result (µg/m³)		Result (µg/m³)		Result (µg/m³)		Result (µg/m³)		Result (µg/m³)		Result (µg/m³)		Result (µg/m³)	
Chloroform	NC	1.95	U	6.1	U	9.67		6.98		5.71		3.05	U	1.95	U	4.88	U	0.977	U	0.977	U
Chloromethane	NC	0.826	U	2.58	U	1.03	U	1.38	U	0.413	U	1.29	U	0.826	U	2.07	U	0.712		1.17	
cis-1,2-Dichloroethene	NC	1.59	U	4.96	U	23.1		2.64	U	5.23		2.48	U	1.590	U	3.96	U	0.079	U	0.079	U
cis-1,3-Dichloropropene	NC	1.82	U	5.67	U	2.27	U	3.03	U	0.908	U	2.84	U	1.82	U	4.540	U	0.908	U	0.908	U
Cyclohexane	NC	4.23		5.99		1.87		4.51		0.688	U	2.15	U	1.38	U	3.44	U	0.688	U	1.67	
Dibromochloromethane	NC	3.41	U	10.6	U	4.26	U	5.68	U	1.70	U	5.32	U	3.41	U	8.52	U	1.7	U	1.7	U
Dichlorodifluoromethane	NC	2.61		6.18	U	3,270		3.3	U	3.13		3.09	U	1.98	U	4.94	U	2.38		2.29	
Ethanol	NC	18.8	U	68		81.6		77.6		14.1		34.1		22.4		76.9		9.42	U	17.4	
Ethyl Acetate	NC	3.60	U	11.20	U	4.61		6.02	U	1.80	U	5.62	U	3.6	U	9.01	U	1.8	U	1.80	U
Ethylbenzene	NC	7.86		10.3		6.52		9.21		5.3		5.73		6.56		8.86		0.87	U	0.87	U
Freon-113	NC	3.07	U	9.58	U	3.83	U	5.11	U	1.53	U	4.79	U	3.07	U	7.66	U	1.53	U	1.53	U
Freon-114	NC	2.80	U	8.74	U	3.49	U	4.66	U	1.40	U	4.37	U	2.80	U	6.99	U	1.4	U	1.40	U
Heptane	NC	8.28		17.4		6.68		15.4		3.82		8.44		9.02		12		0.82	U	0.82	U
Hexachlorobutadiene	NC	4.27	U	13.3	U	5.33	U	7.11	U	2.13	U	6.67	U	4.27	U	10.7	U	2.13	U	2.13	U
Isopropanol	NC	8.23		57.5		30.7		41.5		7.37		33.9		23.5		41.3		1.2	U	10.1	
Methyl tert butyl ether	NC	1.44	U	4.51	U	1.8	U	2.40	U	0.721	U	2.25	U	1.44	U	3.61	U	0.721	U	0.721	U
Methylene chloride	60	3.47	U	10.8	U	4.34	U	5.80	U	1.74	U	5.42	U	3.47	U	8.69	U	11.80		1.79	
n-Hexane	NC	2.67		7.79		3.21		12.6		1.22		3.81		3.8		6.27		0.705	U	1.18	
o-Xylene	NC	7.43		9.12		6.34		10		5.17		5.56		6.12		7.99		0.869	U	0.87	U
p/m-Xylene	NC	17.5		21.3		15.2		25.8		12.6		13		14.2		19.4		1.74	U	1.74	U
Styrene	NC	1.7	U	5.32	U	2.13	U	2.84	U	0.852	U	2.66	U	1.7	U	4.26	U	0.852	U	0.85	U
Tertiary butyl Alcohol	NC	8.09		17.2		22.30		13.4		4.06		9.7		6.82		12.9		1.52	U	1.52	U
Tetrachloroethene	30	447		124		165		327		93		1,480		841		435		2.63		0.271	
Tetrahydrofuran	NC	7.52		9.2	U	3.69	U	4.93	U	1.47	U	4.6	U	2.95	U	7.37	U	1.47	U	1.47	U
Toluene	NC	9.61		14.6		8.25		17.4		6.67		7.5		8.55		11.3		0.754	U	5.2	
trans-1,2-Dichloroethene	NC	1.59	U	4.96	U	1.98	U	2.64	U	0.793	U	2.48	U	1.59	U	3.96	U	0.793	U	0.793	U
trans-1,3-Dichloropropene	NC	1.82	U	5.67	U	2.27	U	3.03	U	0.908	U	2.84	U	1.82	U	4.54	U	0.91	U	0.91	U
Trichloroethene	2	2.15	U	6.72	U	548		5.7		64.50		20.6		14.10		7.31		0.87		0.124	
Trichlorofluoromethane	NC	2.25	U	7.02	U	2.81	U	3.75	U	1.12	U	3.51	U	2.25	U	5.62	U	1.60		1.22	
Vinyl bromide	NC	1.75	U	5.47	U	2.19	U	2.92	U	0.874	U	2.73	U	1.75	U	4.37	U	0.874	U	0.874	U
Vinyl chloride	NC	1.02	U	3.2	U	1.28	U	1.71	U	0.792		1.6	U	1.02	U	2.56	U	0.051	U	0.051	U
Total BTEX	NC	28.99		41.81		26.35		55.85		18.36		22.60		27.07		34.42		0.00		6.38	

Notes:

µg/m³ - Micrograms per cubic meter

NC - No Criteria

U - Non-detect

NYSDOH AGV - New York State Department of Health Air Guideline Values

*Only the results of indoor air samples were compared to the NYSDOH AGVs

Table 14
Steiner Studios
Bush Terminal South Campus
Brooklyn, New York
Summary of Soil Vapor and Indoor Air Analytical Results for Methane

SAMPLE NAME	**TRC-SV-23**		**TRC-SV-24**		**TRC-SV-25**		**TRC-SV-26**		**TRC-SV-27**		**TRC-SV-28**		**TRC-SV-29**		**TRC-SV-30**		**TRC-BLDG-57CS**		**TRC-BLDG-58CS**	
LABORATORY ID NO.	L2010690-03		L2010690-05		L2010690-01		L2010881-01		L2010690-02		L2010881-02		L2010881-03		L2010690-04		L2010881-04		L2010881-05	
DATE SAMPLE COLLECTED	3/10/2020		3/10/2020		3/10/2020		3/11/2020		3/10/2020		3/11/2020		3/11/2020		3/10/2020		3/11/2020		3/11/2020	
MATRIX	SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		SOIL VAPOR		INDOOR AIR		INDOOR AIR	
Fixed Gases (%)	Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)		Result (%)	
Methane	0.161	U	0.154	U	0.182	U	0.169	U	0.175	U	0.169	U	0.182	U	0.145	U	0.196	U	0.196	U

Notes:

% - Percent

U - Non-detect

APPENDIX B

Quality Assurance Project Plan/Field Sampling Plan

Quality Assurance Project Plan/Field Sampling Plan

5000 1st Avenue
Brooklyn, New York

October 1, 2021

Prepared for:

Steiner Sequel, LLC
15 Washington Avenue
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Prepared by:

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Attachments

1. Introduction

Roux Environmental Engineering and Geology, D.P.C. (Roux), on behalf of Steiner Sequel, LLC (Applicant), has prepared this Quality Assurance Project Plan/Field Sampling Plan (QAPP/FSP) to describe the measures that will be taken to ensure that the data generated during performance of the Remedial Investigation Work Plan/Interim Remedial Measure Work Plan (RIWP/IRMWP) Work Plan for the Former Bush Terminal site located at 5102 1st Avenue, Brooklyn, New York 11232 (Site) are of quality sufficient to meet project-specific data quality objectives (DQOs). This QAPP/FSP also includes field sampling procedures.

As of the date of this RIWP/IRMWP, the Applicant is concurrently submitting a Brownfield Cleanup Program (BCP) application to the New York State Department of Environmental Conservation (NYSDEC) in April 2021 with the goal to investigate and remediate the Site as a Volunteer in the BCP. This QAPP/FSP was prepared in accordance with the guidance provided in NYSDEC's DER-10, Technical Guidance for Site Investigation and Remediation (DER-10) dated May 2010, the NYSDEC BCP Guide, and the United States Environmental Protection Agency's (USEPA's) Guidance on Systematic Planning using the Data Quality Objectives Process (EPA QA/G-4) dated February 2006.

1.1 Purpose

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

This QAPP/FSP was prepared in accordance with the NYSDEC's DER-10 and provides guidelines and procedures to be followed by field personnel during performance of sampling during the RI/IRM. Information contained in this QAPP/FSP relates to:

- sampling objectives (Section 2);
- project organization (Section 3);
- sample media, locations, analytical suites, and frequency (Section 4);
- field sampling procedures (Section 5);
- sample handling, sample analysis, and QA/QC (Section 6); and
- Site control procedures and decontamination (Section 7).

2. Sampling Objectives

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

Previous investigations at the Site have documented the presence of soil, groundwater, and soil vapor contamination due to the former use of the Site for various manufacturing purposes, a rail yard, a port terminal, a contractor yard, and a trucking company, former structures present at the Site, and the presence of historic fill materials.

Based on the existing data for the Site and data gaps in Site coverage, the sampling objectives of the RI/IRM are as follows:

- Identify historical AOCs and delineate the nature and extent of potential impacts to soil, groundwater, and soil vapor within the Site;
- Collect sufficient data to perform a qualitative human health exposure assessment (QHHEA) for onsite and offsite receptors; and
- Analyze onsite reuse soil, if necessary, and offsite material to evaluate its suitability for use as backfill that meets the lower of the Protection of Groundwater Soil Cleanup Objectives (PGWSCOs) or the Industrial Use Soil Cleanup Objectives (IUSCOs) for the Site.

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

3. Project Organization

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

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

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

Project Manager
Lauren Dolginko will serve as the Project Manager. The Project Manager is responsible for defining project objectives and bears ultimate responsibility for the successful completion of the work. This individual will provide overall management for the implementation of the scope of work and will coordinate all field activities. The Project Manager is also responsible for data review/interpretation and report preparation.

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

Laboratory Project Manager
Laboratory analysis will be completed by TestAmerica Laboratories of Edison, New Jersey, Sacramento, California, and Burlington, Vermont, New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratories (11452, 11666, and 10391, respectively). The Laboratory Project Manager is Melissa Haas. The Laboratory Project Manager is responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of the laboratory staff. The Laboratory Project Manager will ensure that QA procedures are followed and that an acceptable laboratory report is prepared and submitted. The Laboratory Project Manager reports to the Project Principal and Project Manager.

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

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

The media to be sampled during the RI/IRM includes soil, groundwater, and soil vapor. Sampling locations, analytical suites, and frequency may vary by medium. A discussion of the sampling schedule for each medium is provided below, while the assumed number of field samples to be collected for each medium, including QC samples, is included in Tables 1 and 2. Specifics regarding the collection of samples at each location and for each task are provided in Section 5 of this QAPP/FSP.

4.1 Soil Sampling

Soil samples are to be used to determine the nature and extent of the known contamination at the Site, evaluate AOCs, and obtain a current representation of the environmental conditions at the Site. A total of 19 soil borings are proposed to be installed at the locations shown in Figure 9 of the RIWP/IRMWP.

Nineteen soil borings will be installed using a Geoprobe drill rig or test pit, depend on Site logistics and investigation schedule. Each soil boring will be advanced to the targeted sample interval summarized in Table 1 below for soil borings and to approximately 20 ft below land surface (ft bls) for locations to be converted into a monitoring well. Prior to advancement with a drill rig, each boring location will be cleared to a depth of five ft bls using hand tools (e.g., post-hole digger, shovel, hand-auger, etc.) and/or a vacuum excavator to identify if any shallow utilities or other obstructions are present. Pre-clearance will not be completed if samples are collected via test pit. Soil from each soil boring will be visually inspected for evidence of impacts and screened for organic vapors in the field using a photoionization detector (PID). Soil lithology will be recorded according to the Unified Soil Classification System (USCS).

Table 1. Summary of Areas of Concern and Soil Sample Rationale

AOC ID	AOC Rationale	Sample Location IDs	Target Soil Sample Depths	Anticipated Sample Collection Method
AOC-1	Presence of soil and groundwater contamination due to several onsite releases, summarized in Section 2.3.5, including petroleum hydrocarbons, chlorinated solvents, and pesticides. Soil borings and monitoring wells will be installed Site-wide to fill in the spatial distribution of analytical data.	RXSB-1/RXMW-1	0-2 ft	Soil boring
			9-11 ft[1]	
		RXSB-2/RXMW-2	0-2 ft	Soil boring
			4-6 ft[1]	
		RXSB-3/RXMW-3	0-2 ft	Soil boring
			4-6 ft[1]	
		RXSB-4/RXMW-4	0-2 ft,	Soil boring
			5-7 ft[1]	
		RXSB-5	0-2 ft,	Soil boring or test pit
			9-11 ft[1]	
		RXSB-7	0-2 ft	Soil boring or test pit
			9-11 ft[1]	
		RXSB-10	0-2 ft	Soil boring or test pit
			7-9 ft[1]	
		RXSB-11	0-2 ft	Soil boring or test pit
			7-9 ft[1]	

AOC ID	AOC Rationale	Sample Location IDs	Target Soil Sample Depths	Anticipated Sample Collection Method
AOC-2	Presence of soil contamination due to inadvertent releases associated with the Site's industrial and manufacturing history as a distribution center including several warehouses and a rail yard. Additional soil borings will be installed adjacent to the remaining and former locations of the historical warehouses to evaluate potential inadvertent releases associated with the loading/unloading area located adjacent to the building loading docks and the rail lines.	RXSB-6	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-8	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-9	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-15	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-16	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-17	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-18	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
		RXSB-19	0-2 in[4]	Soil boring or test pit
			1-3 ft[2]	Soil boring or test pit
AOC-3	Evaluation of the potential presence of soil and groundwater contamination below unit G, which currently is identified as a data gap with no analytical data within the footprint of the currently vacant building.	RXSB-12/RXTW-1	8-10[1]	Soil boring
		RXSB-13/RXTW-2	8-10[1]	Soil boring
		RXSB-14/RXTW-3	8-10[1]	Soil boring
		RXMW-5	NA[3]	NA
		RXMW-6	NA[3]	NA
		RXMW-7	NA[3]	NA
AOC-4	Confirmation and evaluation of TCE detection at soil vapor sample location SV-2, collected during the 2013 RI.	RXSV-1	NA	Soil boring
		RXSV-2	NA	Soil boring
		RXSV-3	NA	Soil boring
AOC-5	Buildings 57 and 58 potential soil vapor intrusion evaluation.	RXIA-57-1	NA	NA
		RXIA-57-2	NA	NA
		RXIA-58-1	NA	NA
		RXIA-57-2	NA	NA

1 - Soil sample will be collected from the two-foot interval exhibiting the greatest evidence of impact (elevated PID detections, odors, or staining). If no evidence of impacts is observed during soil boring advancement, the soil sample will be obtained from the two-foot interval immediately above the water table.

2 – Sample to be collected from the two-foot interval directly below remaining historical rail lines.

3 – Groundwater sample will be collected from existing onsite monitoring wells, as depicted on Figure 9, following confirmation of well construction and conditions. If well construction cannot be confirmed and/or monitoring wells are found to be in poor condition, new permanent wells will be installed, gauged, and sampled as detailed in Section 3.2.3 of the RIWP/RIWMP.

4 – Soil sample to be collected from the 0-2 inch interval below the vegetative cover (if applicable) of representative onsite historical soil. Soil to be sampled will not include existing onsite asphalt, concrete, recycled concrete aggregate (RCA) subbase, rail line track ballast, or soil exhibiting characteristics of previously imported clean material. The 0-2 inch soil samples will not be analyzed for emerging contaminants.

Appropriate QA/QC samples will be collected based on applicable guidance. Additional samples may be required if evidence of impacts is observed.

Soil samples collected as part of the RI will be analyzed for the following list of parameters:

- Target Compound List (TCL)/NYSDEC Part 375 volatile organic compounds (VOCs);
- TCL/NYSDEC Part 375 semivolatile organic compounds (SVOCs);
- TCL/NYSDEC Part 375 pesticides;
- TCL/NYSDEC Part 375 herbicides;
- TCL/NYSDEC Part 375 Polychlorinated Biphenyls (PCBs);
- Total Analyte List (TAL)/NYSDEC Part 375 metals (including hexavalent chromium, trivalent chromium, and total cyanide); and
- Emerging Contaminants* (ECs) (excluding sample collected from 0-2 inches bls).

* EC list includes 1,4-Dioxane and Per- and Polyfluoroalkyl Substances (PFAS) which include the 21 compounds listed in the NYSDEC January 2021 Guidelines for Sampling and Analysis of PFAS Under NYSDEC's Part 375 Remedial Programs (NYSDEC January 2021 Guidance). The NYSDEC January 2021 Guidance is provided in Attachment 2. PFAS in soil will be analyzed for via USEPA Method 537 Modified and 1,4-Dioxane in soil will be analyzed for via USEPA Method 8270E. The reporting limit for PFAS in soil is 0.5 microgram per kilogram (ug/kg). The reporting limit for PFAS in groundwater is 2 nanograms per liter (ng/L). The 21 PFAS are:

- Perfluorobutanesulfonic acid;
- Perfluorohexanesulfonic acid;
- Perfluoroheptanesulfonic acid;
- Perfluorooctanesulfonic acid;
- Perfluorodecanesulfonic acid;
- Perfluorobutanoic acid;
- Perfluoropentanoic acid;
- Perfluorohexanoic acid;
- Perfluoroheptanoic acid;
- Perfluorooctanoic acid;
- Perfluorononanoic acid;
- Perfluorodecanoic acid;
- Perfluoroundecanoic acid;
- Perfluorododecanoic acid;
- Perfluorotridecanoic acid;
- Perfluorotetradecanoic acid;
- 6:2 Fluorotelomer sulfonate;
- 8:2 Fluorotelomer sulfonate;
- Perfluorooctanesulfonamide;

- N-methyl perfluorooctanesulfonamidoacetic acid; and
- N-ethyl perfluorooctanesulfonamidoacetic acid.

4.2 Groundwater Sampling

To characterize onsite groundwater flow and quality conditions, four new permanent groundwater monitoring wells and three new temporary monitoring wells will be installed for sampling and analysis. Additionally, three existing onsite monitoring wells located downgradient of buildings 57, 58, and unit G, will be sampled, following confirmation of monitoring well construction and conditions. If well construction cannot be confirmed and/or the three monitoring wells are found to be in poor condition, three new permanent wells will be installed, gauged, and sampled. Based on data from previous environmental reports, it is assumed that groundwater will be encountered at approximately 10 to 15 ft bls. The new permanent groundwater monitoring wells will be installed to approximately 15 to 20 ft bls, depending on the depth at which groundwater is encountered at each location. All monitoring wells will be installed with a ten-foot well screen bridging the water table (i.e., three feet of well screen above the water table and seven feet of well screen below). The proposed groundwater monitoring well locations are shown on Figure 9 of the RIWP/IRMWP and monitoring well installation and groundwater sampling procedures are outlined below in Section 5.2.

Groundwater samples collected as part of the RI will be analyzed for the following list of parameters:

- TCL/NYSDEC Part 375 VOCs;
- TCL/NYSDEC Part 375 SVOCs;
- TCL/NYSDEC Part 375 pesticides;
- TCL/NYSDEC Part 375 herbicides;
- TCL/NYSDEC Part 375 PCBs;
- TAL/NYSDEC Part 375 total and dissolved metals (including hexavalent chromium, trivalent chromium, and total cyanide); and
- ECs.

The TestAmerica Standard Operating Procedures (SOPs) for completing EC analysis and reporting limits/minimum detection limits for EC compounds are included in Attachment 4. Reporting limites for ECs are also summarized below:

Table 2. Reporting Limits for EC Compounds in Groundwater and Soil

Analyte	Groundwater Reporting Limit (ng/L)	Soil Reporting Limit (ug/kg)
Perfluorobutanoic acid (PFBA)	2.00	0.200
Perfluoropentanoic acid (PFPeA)	2.00	0.200
Perfluorohexanoic acid (PFHxA)	2.00	0.200
Perfluoroheptanoic acid (PFHpA)	2.00	0.200
Perfluorooctanoic acid (PFOA)	2.00	0.200
Perfluorononanoic acid (PFNA)	2.00	0.200
Perfluorodecanoic acid (PFDA)	2.00	0.200

Analyte	Groundwater Reporting Limit (ng/L)	Soil Reporting Limit (ug/kg)
Perfluoroundecanoic acid (PFUnA)	2.00	0.200
Perfluorododecanoic acid (PFDoA)	2.00	0.200
Perfluorotridecanoic acid (PFTriA)	2.00	0.200
Perfluorotetradecanoic acid (PFTeA)	2.00	0.200
Perfluorobutanesulfonic acid (PFBS)	2.00	0.200
Perfluorohexanesulfonic acid (PFHxS)	2.00	0.200
Perfluoroheptanesulfonic acid (PFHpS)	2.00	0.200
Perfluorooctanesulfonic acid (PFOS)	2.00	0.500
Perfluorodecanesulfonic acid (PFDS)	2.00	0.200
Perfluorooctanesulfonamide (FOSA)	2.00	0.200
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	20.0	2.00
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	20.0	2.00
6:2 FTS	20.0	2.00
8:2 FTS	20.0	2.00

Field parameters (pH, temperature, turbidity, conductivity, oxidation-reduction potential [ORP], and dissolved oxygen) will also be collected in the field using a water quality meter during purging prior to sample collection.

4.3 Soil Vapor Sampling

Three soil vapor samples and four indoor air samples will be collected during the RI portion of this RIWP/IRMWP to evaluate soil vapor conditions and evaluate potential soil vapor intrusion at buidlings 57 and 58 at the Site. The proposed soil vapor sampling locations are shown on Figure 9 of the RIWP/IRMWP. All soil vapor samples will be collected in accordance with the October 2006 NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York (updated May 2017; NYSDOH Guidance) and June 2015 OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air (USEPA Soil Vapor Guidance). All soil vapor samples will be analyzed for VOCs using USEPA Method TO-15. Soil vapor point installation and soil vapor sampling procedures are outlined below is Section 5.3.

5. Field Sampling Procedures

This section provides a detailed discussion of the field procedures to be used during sampling of the various media being evaluated as part of the RI/IRM (i.e., soil, groundwater, and soil vapor). As discussed, the sample locations are shown on Figure 9 of the RIWP/IRMWP. Additional details regarding sampling procedures and protocols are described in Roux's relevant SOPs, which are provided in Attachment 3.

5.1 Soil Sampling and Monitoring Well Installation

Details for the collection of soil samples and the installation of groundwater monitoring wells are provided below. Dependent on Site logistics and investigation schedule, soil samples may be collected via soil boring completed using a Geoprobe direct push drill rig or a test pit by an excavator. At soil boring locations, pre-clearance will be completed to five ft bls using non-intrusive methods (i.e., hand auger, vacuum technology, etc.) prior to advancement of soil borings to verify the absence of potential underground utilities. Should a utility or other feature be observed during pre-clearance activities, the sampling location will be relocated to no greater than ten feet away from the original proposed location. Should the sampling location need to be located at a distance greater than ten feet from the original proposed location due to access constraints, Roux will contact the NYSDEC case manager for approval.

5.1.1 Soil Sampling

Soil will be collected continuously from land surface to the targeted sample interval as summarized in Table 1. If a soil boring is collocated with permanent or temporary monitoring well locations, soil will be collected continuously to a depth of approximately 15 to 20 ft bls, based on the observed water table depth.

The soil from each five foot interval will be observed for lithology and evidence of contamination (e.g., staining, odors, and/or visible free product) and placed immediately thereafter into large Zip-loc™ bags for recording headspace using a PID. After a minimum of 15 minutes for equilibration with the headspace in the Zip-loc™ bag, each sample will be screened for organic vapors using a PID equipped with a 10.6 eV lamp. Samples collected for VOC analysis will be placed in a laboratory-supplied jar or EnCore sampler prior to screening, due to the potential for loss of VOCs through volatilization. Soil samples will be analyzed for the parameters described above in Section 4.1. These samples will be placed in the laboratory-supplied containers and shipped to the laboratory under chain of custody procedures in accordance with Roux's SOPs, included in Attachment 3.

Following sample collection, the boreholes will be backfilled with soil cuttings and patched with concrete or asphalt to restore the location to pre-existing conditions. Contaminated soil cuttings, if encountered, will be placed in sealed and labeled United States Department of Transportation (DOT) approved 55-gallon drums pending characterization and offsite disposal at a permitted facility.

All soil sampling activities will be completed in accordance with the NYSDEC January 2021 Guidance. Additional necessary precautions will be taken when sampling for ECs in the field, including, but not limited to:

- Using the proper field clothing or personal protective equipment (PPE) (i.e. no materials will contain Gore-Tex or Tyvek);
- Avoid using Grundfos and bladder pumps and sampling equipment components/containers making contact with aluminum foil, low-density polyethylene (LDPE), glass, or polytetrafluoroethylene materials;

- Following PFAS field sampling guidelines (i.e. using sampling materials made from high-density polyethylene [HDPE], silicon, or stainless steel and avoid using equipment containing Teflon and using sharpies, permanent markers, adhesives, and waterproof/plastic clipboards and notebooks); and
- Utilizing regular ice for sample presevation and only Alconox or Liquinox for decontamination.

5.1.2 Monitoring Well Installation

Following soil sampling activities, monitoring wells will be installed bridging the water table and to a maximum depth of approximately 15 to 20 ft bls. Monitoring wells will be constructed of two-inch inside diameter, schedule 40 polyvinyl chloride (PVC) casing and 0.020-inch slot machined screen. Well screens will be ten feet long, and will be installed with three feet of well screen above and seven feet of well screen below the water table. A sand pack will be placed around the well screen, extending two feet above the top of the screened zone. Once the driller confirms the depth of the sand pack, a minimum two-foot-thick bentonite pellet seal will be placed above the sand pack. The permanent wells will be completed using locking well plugs, and flush-mounted, bolt down, watertight, manhole covers cemented into place.

Each of the four newly installed permanent monitoring wells will be developed to remove any fine-grained material in the vicinity of the well screen and to promote hydraulic connection with the aquifer. The wells will be developed using a submersible pump, which will be surged periodically until well yield is consistent and has a turbidity below 50 Nephelometric turbidity units (NTUs).

5.2 Groundwater Sampling

Groundwater samples will be collected no sooner than one week following development of the wells. Prior to sampling, depth to water will be measured at each well using an electronic water level meter with an accuracy of +/ 0.01 feet. All wells will then be purged and sampled using a submersible pump or low-flow method, or an alternative method, depending on the observed depth to groundwater and logistical requirements. Purging and sampling will be performed consistent with USEPA low-flow sampling requirements. Field parameters (pH, temperature, turbidity, conductivity, ORP, and dissolved oxygen) will be collected using a water quality meter with a flow-through cell until parameters stabilize before samples are collected. Groundwater samples will be analyzed for the parameters described above in Section 4.2.

All groundwater sampling activities will be completed in accordance with the NYSDEC January 2021 Guidance. Additional necessary precautions will be taken when sampling for ECs in the field, including, but not limited to:

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

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

5.3 Soil Vapor Sampling

One soil vapor sample and four indoor air samples will be collected during the RI to evaluate soil vapor conditions and potential soil vapor intrusion at buildings 57 and 58 at the Site. The one soil vapor monitoring point will be installed at approximately two feet above the observed water table based on field observations while advancing soil borings.

New Teflon® lined tubing will be attached to an expendable soil vapor sampling point with a 6-inch stainless steel screen inside the rods, to prevent infiltration of ambient air. The soil vapor points will be backfilled with #2 Morie sand to approximately one foot above the screen, as practical. Prior to sample collection, the Teflon®-lined tubing will be purged of approximately two volumes of the tubing using a vacuum pump set at a rate of 0.2 liters per minute. A tracer gas (i.e., helium) will be used to enrich the atmosphere in the immediate vicinity of the sampling location in order to test the borehole seal and verify that ambient air is not being drawn into the sample in accordance with the procedures outlined in the NYSDOH Guidance. Following purging and verification with the tracer gas, the tubing will be connected to the pre-cleaned (batch-certified) laboratory supplied six-liter summa canister.

The four indoor air samples will be collected over an eight hour period at the breathing zone from the lowest floor proposed to be occupied as part of the redevelopment of buildings 57 and 58. A NYSDOH Indoor Air Quality Questionnaire and Building Inventory form (Attachment 5) will be completed as part of the indoor air sampling at buildings 57 and 58.

All soil vapor samples will be collected using the canisters with regulators calibrated to collect samples over a 2-hour period and analyzed using USEPA Method TO-15 for VOCs.

6. Sample Handling, Sample Analysis, and QA/QC

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

6.1 Field Sample Handling

A discussion of the proposed number and types of samples to be collected during each task, as well as the analyses to be performed, can be found in Section 4.0 of this QAPP/FSP. The types of containers, volumes, and preservation techniques for the aforementioned testing parameters are presented in Table 3.

6.2 Sample Custody Documentation

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

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

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

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

6.3 Sample Shipment

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

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

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

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

6.4 QA/QC

Judy Harry, a third-party data validator, will review the analytical data for QA/QC and prepare the Data Usability Summary Report (DUSR) in accordance with NYSDEC standards. Validator resume is included in Attachment 1. A laboratory SOP for analysis of PFAS is included in Attachment 4.

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

Sensitivity is also a critical issue in generating representative data. Laboratory equipment must be of sufficient sensitivity to detect target compounds and analytes at levels below NYSDEC standards and guidelines whenever possible. Equipment sensitivity can be decreased by field or laboratory contamination of samples and by sample matrix effects. Assessment of instrument sensitivity is performed through the analysis of reagent blanks, near-detection-limit standards, and response factors. Potential field and/or laboratory contamination is assessed through use of trip blanks, method blanks, and equipment rinse blanks (also called "field blanks").

Table 1 lists the requirements for field and laboratory QC samples that will be analyzed to assess data accuracy and precision, as well as to determine if equipment sensitivity has been compromised. Table 2 lists the number/type of field and QA/QC samples that will be collected during the RI/IRM. Table 3 lists the preservation, holding times, and sample container information.

All RI “assessment” analyses will be performed in accordance with the NYSDEC Analytical Services Protocol (ASP), using USEPA SW 846 methods.

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

7. Site Control Procedures and Decontamination

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

7.1 Decontamination

In an attempt to avoid the spread of contamination, all drilling and sampling equipment must be decontaminated at a reasonable frequency in a properly designed and located decontamination area. Detailed procedures for the decontamination of field and sampling equipment are included in Roux's SOPs included in Attachment 3. The location of the decontamination area will be determined prior to the start of field operations. The decontamination area will be constructed to ensure that all wash water generated during decontamination can be collected and containerized for proper disposal. All decontmination will be completed using the standard two step process using detergent (Alconox or Liquinox) and clean, PFAS-free water for sample equipment. All water sources used for equipment decontamination during EC sampling of groundwater or soil will be verified in advance to be PFAS-free through laboratory analysis or certification, in accordance with the NYSDEC January 2021 Guidance.

7.2 Investigation Derived Waste Handling and Disposal

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

TABLES

Table 1. Field and Laboratory QC Summary

QC Check Type	Minimum Frequency	Use
Field QC		
Duplicate**	1 per matrix per 20 samples or SDG*	Precision
Trip Blank**	1 per VOC cooler	Sensitivity
Field Blank**	1 per matrix per sample delivery group	Sensitivity
Laboratory QC		
Laboratory Control Sample	1 per matrix per SDG	Accuracy
Matrix Spike/Matrix Spike Duplicate/Matrix Duplicate**	1 per matrix per 20 samples	Accuracy/Precision
Surrogate Spike	All organic samples	Accuracy
Laboratory Duplicate	1 per matrix per SDG	Precision
Method Blank	1 per matrix per SDG	Sensitivity

Notes:

QC - Quality Control

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

** Provided to lab by field sampling personnel

Table 2. RI/IRM Sampling Summary

Sample Matrix	Target Analytes	Field Samples	Replicates[1]	Trip Blanks[2]	Field Blanks[3]	Matrix Spikes[1]	Spike Duplicates[1]	Total No. of Samples
RI Soil	TCL/Part 375 VOCs	35	2	10	10	2	2	61
	TCL/Part 375 SVOCs	35	2	-	10	2	2	51
	TCL/Part 375 Pesticides	35	2	-	10	2	2	51
	TCL/Part 375 Herbicides	35	2	-	10	2	2	51
	Total Cyanide	35	2	-	10	2	2	51
	TCL/Part 375 PCBs	35	2	-	10	2	2	51
	TAL/Part 375 Metals	35	2	-	10	2	2	51
	PFAS, 1,4 Dioxane	35	2	-	10	2	2	51
RI Groundwater	TCL/Part 375 VOCs	10	1	2	10	1	1	25
	TCL/Part 375 SVOCs	10	1	-	10	1	1	23
	TCL/Part 375 Pesticides	10	1	-	10	1	1	23
	TCL/Part 375 Herbicides	10	1	-	10	1	1	23
	Total Cyanide	10	1	-	10	1	1	23
	TCL/Part 375 PCBs	10	1	-	10	1	1	23
	TAL/Part 375 Metals*	10	1	-	10	1	1	23
	PFAS, 1,4 Dioxane	10	1	-	10	1	1	23
RI Soil Vapor	TO-15 VOCs	5	1	-	-	-	-	6

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

[1] Based on 1 per 20 samples

[2] Based on 1 cooler per day (10 days max)

[3] Based on 1 per matrix per sample delivery group (10 days max)

QA - Quality Assurance
QC - Quality Control
RI - Remedial Investigation
TCL - USEPA Contract Laboratory Program Target Compound List
USEPA - United States Environmental Protection Agency
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls
PFAS - Per- and Polyfluoroalkyl Substances
TAL - USEPA Contract Laboratory Program Target Analyte List
*All groundwater samples will be analyzed for both total and dissolved metals.

Table 3. Preservation, Holding Times, and Sample Containers

Analysis	Matrix	Bottle Type	Preservation(a)	Holding Time(b)
TAL Metals (total)	Soil	8 oz wide mouth glass, teflon lined cap	Cool to 6°C	180 days, Hg 28 days
SW-846 6010/60210/7471A/7470	Water	250 mL plastic, teflon lined cap	Nitric acid	
Total Cyanide	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 6°C	14 days
SW-846 9021B	Water	250 mL amber glass or plastic, teflon lined cap	NaOH	14 days
PFAS via USEPA 537(M)	Soil	250 mL HDPE wide mouth jar	Cool to 6°C	14 days to extract, 40 days to analysis
PFAS via USEPA 537(M)-Isotope Dilution (WATER)	Water	2 x 250mL HDPE	Trizma	14 days to extract, 40 days to analysis
1,4-Dioxane via 8270E	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 6°C	7 days to extract, 40 days to analysis
1,4-Dioxane via 8270SIM	Water	500 mL amber glass	Cool to 6°C	7 days to extract, 40 days to analysis
TO-15	Air	2.7 or 6 liter Summa Canister	None	30 days
TCL				
TCL VOCs	Soil	EnCore	Cool to 6°C	48 hours from sample collection, 14 days if frozen to -7°C or extruded into methanol
SW-846 8260	Water	3 x 40 mL voa vial, teflon lined cap	Hydrochloric Acid	14 days
TCL SVOCs	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 6°C	14 days to extract, 40 days to analysis
SW-846 8270	Water	2 x 8 oz amber glass or plastic, teflon lined cap	Cool to 6°C	7 days to extract, 40 days to analysis
TCL Pesticides	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 6°C	14 days to extract, 40 days to analysis
SW-846 8081	Water	2 x 8 oz amber glass or plastic, teflon lined cap	Cool to 6°C	7 days to extract, 40 days to analysis
TCL Herbicides	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 6°C	14 days to extract, 40 days to analysis
SW-846 8151	Water	2 x 8 oz amber glass or plastic, teflon lined cap	Cool to 6°C	7 days to extract, 40 days to analysis
TCL PCBs	Soil	4 oz wide mouth glass, teflon lined cap	Cool to 6°C	365 days to extract, 40 days to analysis
SW-846 8082	Water	2 x 8 oz amber glass or plastic, teflon lined cap	Cool to 6°C	365 days to extract, 40 days to analysis

(a) All soil and groundwater samples to be preserved on ice during collection and transport

(b) Days from date of sample collection.

TAL - USEPA Contract Laboratory Program Target Analyte List
PFAS - Per- and Polyfluoroalkyl Substances
USEPA - United States Environmental Protection Agency
TCL - USEPA Contract Laboratory Program Target Compound List
VOCs - Volatile Organic Compounds
SVOCs - Semivolatile Organic Compounds
PCBs - Polychlorinated Biphenyls

ATTACHMENTS

1. Professional Profiles
2. NYSDEC PFAS Guidance
3. Roux's Standard Operating Procedures
4. Laboratory's Standard Operating Procedures
5. New York State Department of Health Indoor Air Questionnaire

ATTACHMENT 1

Professional Profiles

ROUX
PROFESSIONAL PROFILE

Frank Cherena, P.G., LEP

Principal Geologist/Brownfield & Due Diligence Practice Area Lead

TECHNICAL SPECIALTIES

Conducted, managed, or overseen Phase I and Phase II investigations and remediation at contaminated sites, specializing in developing innovative cost-saving solutions that focus on integrating remedies into redevelopment scenarios. Experience working with multiple agencies and stakeholders including negotiation and coordination with lenders, tenants, and community stakeholders to secure funding and approvals.

EXPERIENCE SUMMARY

Seventeen years of experience: Principal Geologist with Roux Associates, Inc., Islandia, New York; Staff Geologist with RTP Environmental Associates, Inc., Green Brook, New Jersey.

CREDENTIALS

B.A., Geology, Colgate University, 2003

OSHA 40-Hour Hazardous Materials Training, 2003

OSHA 8-Hour Supervisor Training, 2004

Accredited AHERA Inspector, 2004

NJ UST Subsurface Evaluator Certification# 491925

New York Licensed Professional Geologist #720

Connecticut Licensed Environmental Professional #610

KEY PROJECTS

- Principal in charge of large university tech development project in New York City. The project consists of the demolition and decommissioning of a former hospital building, and excavation for redevelopment of four separate buildings for the first phase of campus construction. Environmental considerations on the project included site assessment, remediation design and oversight, SDPES permitting (construction dewatering and geothermal well discharge), soil characterization for reuse and capping of soils. Coordinated with NYCDEP, and other project stakeholders concerning community protection and monitoring concerns.

- Principal in charge of redevelopment of a former powerplant into an industrial arts complex. Remediation consisted of removal and containment of TSCA-regulated PCB-impacted soils, groundwater, and building material, and remediation waste. Successfully obtained Certificate of Completion for NYSDEC BCP, clean up and continue to coordinate Site redevelopment activities under a Site Management Plan. Included significant coordination and correspondence with USEPA to negotiate installation of a consent order for bulkhead installation along the Gowanus Canal Superfund Site.

- Principal in charge of redevelopment of shopping mall in Staten Island, New York. The Site will consist of the construction of two commercial out parcel buildings, a new parking deck, and an expansion of the existing mall building. Areas of concern include historical fill, site-wide soil contamination (arsenic and pesticides). In addition, also responsible for agency coordination with FDNY, NYSDEC, and NYCOER for mitigation of methane and chlorinated volatile organic compounds vapor issues.

- Principal-in-Charge for the redevelopment of a 5-acre live-work-play campus in Hunts Point, Bronx. The residential component of the Project is comprised of 100% affordable housing, and is currently enrolled in the NYSDEC BCP. Mr. Cherena has also negotiated/coordinated with lenders, coordinated with multiple disciplines on the design team to create a RAP to comply with NYCOER air/noise requirements, and assisted in remedial design and estimation.

- Principal in charge for new development of a large regional mall in Norwalk, Connecticut with underground parking. The proposed redevelopment will result in the construction of a retail shops, restaurants, hotel, and entertainment. Previous usage of the property included over 30 different parcels including three establishments, gasoline filling stations, fuel oil terminal storage, hazardous waste disposal areas. The project includes investigation and subsequent remediation of petroleum and hazardous waste releases, filing of the Environmental Conditions Assessment Form (ECAF) associated with the three transfer act parcels, and coordination with the CT DEEP and CT DECD to obtain CT Brownfields Grant funds.

- Principal in charge for two adjoining multifamily NYSDEC BCP redevelopment sites in Mott Haven, Bronx, New York along the Harlem River. Project includes characterization, excavation, and disposal of over 40,000 tons of soil, support for obtaining a SPDES discharge permit for construction water, along with attending public meetings and creating public participation plans. Project task includes community air monitoring, shoreline permitting, and construction monitoring while minimize cost impact by sharing resources between both projects.

- Principal in charge for the largest redevelopment project in New York City (over $4.5 billion). Project includes Phase I and Phase II ESAs (investigation of soil, groundwater, and soil vapor) at over 75 properties; Construction support for excavation of one million cubic yards of soil including implementing an *in situ* waste characterization program; Environmental support for demolition, asbestos and lead abatement, site remediation using *In Situ* Chemical Oxidation, and relocating of an active 9-acre 100-year old railyard; Property acquisition support throughout the project (7 city blocks); and Agency support for NYSDEC, NYCDEP, MTA (LIRR/NYCT), and ESDC. The environmental data was used as an integral component of the New York State Environmental Quality Review Act (SEQRA) final Environmental Impact Statement (EIS). The project will encompass 336,000 sq ft of office space, 6.4 million sq ft of residential space, an 18,000 seat sports and entertainment venue - the Barclays Center (home of the Nets professional basketball team) - 247,000 sq ft of retail space, a 165,000 square-foot hotel, and over 8 acres of intricately designed publicly accessible open space.

- Principal in charge of redevelopment and rehabilitation of the Nassau Coliseum Event Center in Uniondale, Long Island, New York. Services included Phase I and Phase II ESA to obtain approvals and entitlements, along with providing consulting services for asbestos abatement and operations and maintenance. Also was responsible for diesel generator tank removal and replacement tank design and installation.

- Principal in charge for a remedial investigation and real estate transaction negotiation for a contaminated former industrial property in Glen Cove, Long Island, New York. Activities included due diligence including document review and historical research to develop and implement a cost efficient investigation scope that was able to identify presence of contamination that was used to negotiate property transaction. Investigation was also designed to develop red mediation and construction budget to support future mixed use redevelopment of the over 12 acre property.

- Principal in charge of numerous due diligence projects for owners, developers, managers, municipalities, and lenders at commercial and industrial properties throughout the Northeast. Activities included performance of UST evaluations and closures, hot spot remediations, Phase I and Phase II Site Assessments, vapor intrusion studies and mitigation, lead based paint, asbestos and hazardous materials surveys, interaction with regulatory agencies on behalf of clients and development of remedial cost estimates for planning and negotiation.

- Principal in charge for investigation and review of a former electroplating facility in Bay Shore, New York with chlorinated solvent DNAPL. Activities included historical document review, subsurface investigation, and coordination with outside legal counsel and NYSDEC.

- Project manager for a property transfer support project at a heavily contaminated state-of-the-art distribution facility in the Bronx, New York. The site was a former MGP being handled under the VCP in central office, the site had an open spill under the regional spills group and the site was attempting to apply to the BCP through the regional office. Roux performed a Phase I for the buyer, a Phase II and remedial cost estimate for the owner and negotiated with the buyer's consultant and NYSDEC to limit the scope of the investigation and cleanup.

- Principal in charge of NYSDEC BCP redevelopment project in Island Park, Long Island, New York. Property was the location of a former oil terminal with extensive degraded petroleum contamination. Contracted services included, management of contaminated soil, import of recycled soil to bring the site above the flood plain, and negotiation with the NYSDEC. Project remediation schedule was extremely tight, and a COC was achieved before the requisite deadline.

- Served as Environmental Professional on hundreds of Phase I Environmental Site Assessments according to ASTM E1527-00, ASTM E1527-05, and ASTM E1527-13 for due diligence of large retail shopping centers, industrial facilities, and office buildings. Associated activities included agency contact, database management and interpretation, report preparation, and recommendations for additional work.

- Implemented GIS analysis and mapping for a remedial study and alternative analysis report (AAR) for an active petroleum storage terminal in Buffalo, New York under jurisdiction of the NYSDEC. The AAR required spatial analyses in order to categorize and analyze contaminant data from multiple investigations, investigate remedial alternatives, and to help focus ongoing additional investigations.

Brian P. Morrissey, P.E., BCEE

Principal Engineer

TECHNICAL SPECIALTIES

Development, design and implementation of soil and groundwater remediation systems.

Optimization of ongoing remedial operations.

Cold eye design review and evaluation of process safety.

Management, support, and oversight of large inter-disciplinary teams for site remediation.

Preparation of feasibility studies, engineer's reports, design drawings, specifications, contract documents, permit applications, cost estimates, operations and maintenance plans and construction management for the following:

- Industrial and sanitary wastewater treatment systems
- *In situ* groundwater remedial technologies
- Sub-slab depressurization systems
- Floating product recovery systems
- Ground water pumping and treatment facilities
- Water supply, treatment, and distribution
- Underground storage tank (UST) systems
- Containment systems
- Air sparging, soil vapor extraction and vapor collection and treatment systems
- Building decontamination and decommissioning
- Landfill cap design and permitting
- Hazardous waste soils removal, transportation, and disposal

EXPERIENCE SUMMARY

More than 30 years of experience working in many areas of the environmental industry under a variety of regulatory programs such as Federal and State Superfund, SPDES, SEQRA, New Jersey ECRA/ISRA, NYSDEC Voluntary Cleanup, Petroleum and Chemical Bulk Storage, and NYC Brownfields.

Principal Engineer and Office Manager at Roux; Senior Engineer and Senior Project Manager at ERM

CREDENTIALS

B.E., Civil Engineering, Cooper Union, 1980

M.S., Civil and Environmental Engineering, NYU Tandon School of Engineering (former Polytechnic), 1985

Professional Engineer: New York (1986), New Jersey (2003), and Virginia (2010)

OSHA 40-hour Health and Safety Training

ExxonMobil Loss Prevention System certified

NYCOER Gold Certified Professional

Board Certified Environmental Engineer (BCEE) of the American Academy of Environmental Engineers and Scientists (AAEES) - Specialty Certification in Hazardous Waste Management, 1995

PROFESSIONAL AFFILIATIONS

Water Environment Federation

KEY PROJECTS

- Project Manager for the design of wastewater treatment plant (WWTP) upgrades at three (3) separate facilities under the program to protect New York City's watershed. The work included preparing conceptual upgrade plans, facility plans, detailed cost estimates, design drawings and specifications, startup plans, O&M plans, and oversight of construction. Design at one facility included replacement of secondary treatment components and the addition of recirculating sand filters, microfiltration units, emergency generator and telemetry systems.
- Principal Engineer and P.E. of Record for the design and construction of a storm drainage and sanitary sewer project located adjacent to a former petroleum terminal in Brooklyn, New York. Worked on several design modifications to obtain NYCDEP approvals. Work included construction of 1,600 linear feet of RCP storm sewer and 1,000 feet of ductile iron sanitary sewer. Construction required vibration monitoring during sheeting and operation and maintenance of a temporary dewatering treatment system.
- Project Engineer for environmental audits at more than 20 commercial and manufacturing facilities to evaluate compliance with federal, state, and local air, wastewater, and hazardous waste regulations. Audits addressed regulatory areas including RCRA, SARA, CWA, CAA, TSCA, and OSHA.
- Principal Engineer for conducting detailed evaluation of problematic groundwater treatment system in Rensselaer, New York. Primary constituents of concern include heavy metals, chlorinated solvents, and BTEX compounds. Developed performance testing program, diagnosed causes of problems and presented several recommendations for upgrading systems and improving personnel health and safety. Prepared engineering report with key recommendations that included modifying equipment layout, injecting iron deposition and calcium scale control agents into water stream, and upgrading the system instrumentation and controls.
- Principal Engineer and Project Manager for the remediation and monitoring of over 100 vehicle fueling sites in New York City with UST petroleum releases. The remediation systems at the various sites include multi-phase extraction, soil vapor extraction, air sparging, groundwater recovery and treatment, and product-only recovery systems. Priorities on this multi-year contract included expediting remedial progress, increasing the effectiveness of operating systems, achieving NFA status, and reducing NYC's overall program costs. Work included conducting soil vapor studies at 9 sites to assess vapor intrusion concerns. Also implemented *in situ* injections at 14 sites to cost-effectively achieve site closure. The *in situ* injections used chemical oxidation and bioremediation products including sodium percarbonate, oxygen generating compounds, hydrogen peroxide, petroleum-degrading bacteria, and nutrient/enzyme complexes.

Brian P. Morrissey, P.E., BCEE
Principal Engineer

- Senior Manager for remedial design and construction oversight at federal Superfund site in Elmira, New York. The 33-acre site included several areas of concern where soil/groundwater were contaminated by several types of hazardous wastes. Managed preparation of design submittals to EPA Region II in accordance with CERCLA guidelines. The soil-sediment remediation design included requirements for materials handling, dewatering and disposal. PCB wastes were segregated and disposed of at TSCA-permitted facility. The design required stabilization of wastes and installation of a RCRA cap. Groundwater remediation system includes 12 recovery wells, filtration and two air strippers.
- Project Manager for upgrading industrial process wastewater treatment system at medical products manufacturing facility in Hancock, New York. The upgraded system removes VOCs and metals, including lead, zinc, and copper, from highly variable waste streams generated by the manufacture of surgical instruments. Prepared design documents for automated system that allows for expected future increase in plant manufacturing capabilities.
- Principal Engineer for design upgrades and expansion of the groundwater depression and separate phase product recovery systems at former petroleum refinery in Brooklyn, NY. Site encompasses one of the nation's largest petroleum releases (18 million gallons). Key components included installation of 10 remote dual-pump free-phase product recovery wells, and modifications to groundwater treatment facilities to optimize performance and system runtime. Redesigned building with new mezzanine and equipment layout to improve flow of the process treatment train.
- Senior Manager for remediation of industrial airport site in Millville, New Jersey under ECRA/ISRA programs. Managed planning, detailed design and permitting activities required to replace 1,000-gpm public supply well impacted by chlorinated solvent plume. Also managed final design of the 200-gpm groundwater recovery, treatment and recharge system that includes ultraviolet light/hydrogen peroxide system controlled by PLCs. This project won the annual Honor Award granted by AAEES.
- Design Manager for evaluation and upgrade of industrial wastewater treatment system for golf shaft manufacturer in Connecticut in accordance with CT DEEP requirements. Options evaluated included assessment of source reduction opportunities, flow segregation, and additional treatment equipment. Inspected the construction and coordinated start-up and testing of the upgraded system which included new tanks, piping, chemical metering pumps, mixers, a continuous flow sludge thickener; and enhanced instrumentation and controls.
- Project Manager for the planning and design of irrigation system using treated wastewater in the Catskills area. Conducted study on acceptable uses of wastewater treated by tertiary methods in accordance with federal and New York State guidance.
- Project Manager for evaluation of wellhead treatment alternative for 1,100-gpm public water supply well in Mineola, NY. Conducted well efficiency tests and investigated existing conditions and future requirements. Prepared design of activated carbon treatment system including building modifications and requirements for well development and replacement of the well pump and controls.
- Design Manager for groundwater recovery and treatment system at a former manufactured gas plant (MGP) in Atlantic Highlands, New Jersey. Developed specification to implement directional drilling under state highway to expand recovery system to capture off-site contamination. System design included PLC-based control software that significantly reduced on-site staffing needs. Also managed construction phase, negotiated/reduced change orders and worked with subcontractors to meet tight regulatory schedule for system start-up. System removes cyanide, metals, VOCs, and free-phase product.
- Senior Engineer for preparing and certifying Spill Prevention Control and Countermeasure (SPCC) Plans for 25 U.S. Postal Service facilities.
- Principal Engineer for the design of modifications to an active sub-slab depressurization system (SSDS) to mitigate chlorinated solvent soil vapor contamination beneath an existing occupied shopping mall in the Bronx, New York. Worked on the coordination and troubleshooting of construction issues. Managed the system testing and start-up and provided recommendations to improve system operation.
- Project Manager for planning, permitting, design and construction oversight of 12,000-foot sewer system for the collection of sanitary and industrial wastewater in Melville, New York. Sewer design included route selection, sizing of gravity sewers, provisions for utility crossings, solar-powered flow meters, grease interceptor, pump station for one branch line, and proper abandonment of leaching facilities. Project included design of two 20,000-gallon underground storage tanks and a tanker truck fill area with secondary containment. Final phase of the project implemented an industrial waste pretreatment system utilizing pH adjustment, filtration, and a bioreactor tank. This project provided a safe and reliable wastewater disposal system and eliminated a costly 40,000-gallon per day hold and haul system.
- Principal Engineer for development of innovative approach for remediation and reuse of federal Superfund site in Plaistow, New Hampshire. Prepared cost estimates for approaches aimed at reducing project costs by utilizing alternate treatment technologies and maximizing efficiency of existing system. Phased approach for site includes hot spot soil removal, enhancements of existing remedial system, implementing air sparging with SVE and follow with polishing step of in situ bioremediation. This alternative plan will achieve environmental restoration of site and is tailored to anticipated re-development of land.

Lauren Dolginko
Project Geologist

TECHNICAL SPECIALTIES

Design, implementation, and management of Remedial Investigations and Remedial Actions for New York State Department of Environmental Conservation Brownfields Cleanup Program (NYSDEC BCP). Management of due diligence Site Assessments; Preparation and management of Brownfield Cleanup Applications, Remedial Investigation Work Plans, Remedial Investigation Reports, Remedial Action Work Plans, and Remedial Action Reports; Investigation and evaluation of petroleum, polychlorinated biphenyl (PCB), and per- and poly fluoroalkyl substances (PFAS)-related contamination; Management of large-scale soil excavation projects including demolition, waste characterization, and construction activities.

EXPERIENCE SUMMARY

Five years of experience: Project Geologist and Staff Geologist, Roux Environmental Engineering and Geology, D.P.C., Islandia, NY

CREDENTIALS

M.S. Geology, SUNY Binghamton University, 2014
B.S. Geology, SUNY Oneonta College, 2012
OSHA 40-Hour HAZWOPER Training, 2014
OSHA Eight-Hour Refresher Training, 2018
OSHA Ten-Hour Construction Outreach Training, 2015
Transportation Worker Identification Credential, 2015
New York State Builders Association Four-Hour Stormwater Training, 2015

KEY PROJECTS

- Project manager for neighboring redevelopment Sites in the NYSDEC BCP, located in Bronx, New York. Responsibilities include the preparation and implementation of NYSDEC-approved investigation work plans and management during construction operations to ensure successful implementation of remedial elements. On-site investigations included hot spot delineation, *in situ* waste characterization sampling, and a NYSDEC Remedial Investigation (including groundwater sampling for emerging contaminants – 1,4-dioxane and PFAAs).

- Project Manager for an affordable housing redevelopment site in the NYSDEC BCP in Bronx, New York. The site was formally used as a juvenile detention center. This project includes a due diligence environmental investigation; remedial investigations (soil, groundwater, and soil vapor); site-wide *in-situ* waste characterization sampling program; a Remedial Action Work Plan; and the management of soil excavations.

- Project manager for soil transfer of over 15,000 cubic yards between Sites in and outside of regulatory agencies. Responsibilities included management and implementation of soil sampling programs in accordance with NYSDEC Part 360 and DER-10, including emerging contaminants (1,4-dioxane and PFAAs).

- Project manager for NYSDEC BCP Site located in Gowanus neighborhood in Brooklyn, New York. Industrial Site history and proximity to Superfund Site Gowanus Canal requires a USEPA-approved remediation. Project includes management and disposal of non-hazardous and TSCA hazardous soil, and oversight of health and safety regulations and contractor during implementation of NYSDEC-approved RAWP.

- Field and remedial construction manager for the largest on-going redevelopment project in New York. Project included subcontractor and health and safety oversight during utility clearance, soil boring installation, and *in-situ* waste characterization sampling. Additional responsibilities consisted of waste disposal and construction management oversight, support for soil excavation, and ensuring compliance with the Site Environmental Management Plan.

- Field manager for environmental subsurface investigation in Enfield, Connecticut. Project responsibilities included managing subcontractors and health and safety oversight during utility clearance; soil boring installation; MIP/CPT soil screening; and groundwater monitoring well installation. Conducted soil sampling and soil lithology classification, groundwater sampling, soil vapor pin installation, and soil vapor sample collection. Office coordination included the creation of soil boring logs using gINT software and assistance with project planning and report preparation.

- Field manager responsible for construction and excavation oversight on Roosevelt Island, New York. Responsibilities included coordination between multiple general contractors and projects by attending weekly construction meetings, excavation support and soil inspection, groundwater dewatering oversight, soil sampling, Community Air Monitoring Plan (CAMP) support, and weekly Stormwater Pollution Protection Plan inspections.

- Field manager for NYS BCP Remedial Investigation in Staten Island, New York. Project responsibilities included health and safety oversight and management of subcontractors during utility clearance, soil boring installation, groundwater monitoring well installation, and soil vapor point installation. Coordinated and completed soil, groundwater, and soil vapor sampling with a team of field staff. Office coordination included the creation of soil boring logs using gINT software and assistance with project planning and report preparation.

- Field manager for *in-situ* waste characterization in Astoria, Queens. Responsibilities included health and safety oversight and management of subcontractors during utility clearance and soil boring installation. Completed soil lithology classification and collection of waste characterization soil samples.

- Subcontractor oversight for bedrock core drilling for non-aqueous phase liquid (NAPL) delineation in Queens, New York. Oversight included inspection of bedrock cores for primary and secondary fractures, evidence of contamination, and completion of rock quality designation (RQD) calculations. Project also included oversight during grout secant wall containment area to cut off NAPL source area. Secant wall oversight included the implementation of a CAMP; health and safety oversight of worker breathing zone; and inspection of drilling secant wall installation to ensure hydraulic seal.
- Field manager at a 1,300-acre former aluminum smelter site in Columbia Falls, Montana, listed as a Superfund site. Fieldwork required coordination with USEPA and soil sampling.
- Support to Expert Witness for an on-going case between a major insurance carrier and a large multi-national chemical manufacturer. The case involved categorizing past costs of 12 chemical sites across the country. Assisted in the preparation of expert report on behalf of insurance carrier (Defendant). Complaint No. 84 Civ. 1968 (JSR); U.S. District Court, Southern District of New York.

ROUX

PROFESSIONAL PROFILE

Patrick Rubenbauer
Project Geologist

TECHNICAL SPECIALTIES

Design, field implementation, and management of Remedial Investigations (RIs) and Remedial Actions (RAs) for sites in regulatory programs including the United States Environmental Protection Agency (USEPA) Superfund program, the New York State Department of Environmental Conservation (NYSDEC) Brownfields Cleanup Program (BCP), and the New York City Office of Environmental Remediation (NYCOER) Voluntary Cleanup Program (VCP). Management of due diligence Phase I and Phase II Environmental Site Assessments (ESAs); preparation and management of Remedial Investigation Work Plans (RIWPs), Remedial Investigation Reports (RIRs), Remedial Action Work Plans (RAWPs), Remedial Action Reports (RARs), Site Management Plans (SMPs), Final Engineering Reports (FERs), and Periodic Review Reports (PRRs). Investigation and evaluation of petroleum, polychlorinated biphenyl (PCB), and per- and polyfluoroalkyl substances (PFAS) contamination. Field and project-level management of large-scale redevelopment projects including remedial construction and soil excavation oversight, management of waste characterization and soil disposal, environmental investigations including the collection of soil, groundwater, sediment, surface water, porewater, concrete, and soil vapor samples using multiple sampling techniques and a variety of analytical methods.

EXPERIENCE SUMMARY

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

CREDENTIALS

B.S. Geological Sciences, Binghamton University, 2017
Amtrak Contractor Orientation, 2020
LIRR Roadway Worker Protection Training, 2020
OSHA 40-Hour HAZWOPER Training, 2017
OSHA 8-Hour HAZWOPER Refresher, 2018
OSHA 8-Hour Refresher Training, current
OSHA 10-Hour Construction H&S Training, 2017
OSHA 30-Hour Construction H&S Training, 2019
Loss Prevention System Awareness, 8-Hour Certified
First Aid, CPR, and AED Certified

KEY PROJECTS

- Field manager / project manager for NYSDEC BCP Site located in the Gowanus neighborhood of Brooklyn, New York. Industrial Site history and proximity to the Gowanus Canal Superfund site requires a blended NYSDEC and USEPA-approved remediation. Responsibilities include implementation of the USEPA-approved workplan for PCB remediation; implementation of a NYSDEC-approved SMP; implementation of the Community Air Monitoring Plan (CAMP); health and safety oversight; oversight of contractors during Site redevelopment; oversight of groundwater dewatering and discharge operations (including groundwater treatment system influent sampling, effluent sampling, and maintenance); implementation of soil sampling programs in accordance with NYSDEC Part 360 and Division of Environmental Remediation (DER-10) requirements, including emerging contaminants (1,4-dioxane and PFAS); preparation of annual PRRs as required by the NYSDEC-approved SMP; management and implementation of quarterly groundwater sampling events as required by the NYSDEC-approved SMP; and revisions to the SMP and USEPA workplan deemed necessary as redevelopment at the site progresses.
- Remedial investigation field manager for an ongoing large and complex mixed-use redevelopment of a 92-acre site located in Syosset, New York. The site was accepted into the NYSDEC BCP and has an extensive environmental history, including former use as a wire and conduit manufacturer (former New York State Inactive Hazardous Waste Site), former landfill (currently a Federal Superfund Site), and town Department of Public Works facility. Activities completed include a groundwater investigation to evaluate the potential presence of PFAS contamination.
- Field manager responsible for the collection of soil, groundwater, surface water, sediment, porewater, and concrete samples at a former aluminum smelter site in Columbia Falls, Montana as part of the USEPA Superfund program feasibility study and remedial investigation.
- Field manager for a high-end residential redevelopment project in Mineola, New York. Responsible for excavation oversight and management of contaminated soils (volatile organic compounds [VOCs] and semivolatile organic compounds [SVOCs]), implementation of the CAMP, soil/drywell sampling, daily reporting, and frequent communication with both the client and contractors. Project included the closure of multiple drywells onsite under USEPA Region 2 and the Nassau County Department of Health.

- Field manager for a site in Jersey City, New Jersey, responsible for drilling oversight and waste characterization of approximately 35,000 cubic yards (CY) of contaminated soil. Suspected contamination included VOCs, SVOCs, metals, PCBs, pesticides, and herbicides. Soil samples were tested under Resource Conservation and Recovery Act (RCRA) and toxicity characteristic leaching procedure (TCLP) parameters. The site was previously used for storage of waste produced by a nearby recycling plant. Onsite responsibilities included extensive investigative sampling and communication with both the contracted drillers and representatives of the client.
- Field manager responsible for construction and excavation oversight of a high-end shopping mall site in Norwalk, Connecticut. Specific responsibilities included oversight of the excavation, soil disposal, and onsite management of approximately 87,000 CY of contaminated soils. Other work in the scope of this project included extensive endpoint/sidewall sampling, oversight of groundwater dewatering operations, and implementation of the CAMP. Onsite remediation was conducted in accordance with the Remediation Standard Regulations and the Connecticut DEEP Department of Energy and Environmental Protection (DEEP) Targeted Brownfield Program. Offsite soil storage for this project necessitated strict adherence to Connecticut DEEP policies, and communication with the client, a variety of onsite contractors, and the Licensed Environmental Professional (LEP).
- Field manager for neighboring redevelopment sites in the NYSDEC BCP, located in Bronx, New York. Responsibilities included the implementation of NYSDEC-approved investigation work plans and management during construction operations to ensure successful implementation of remedial elements. Onsite investigations included hot spot delineation, underground storage tank (UST) removal and spill closure, *in situ* waste characterization sampling, and a NYSDEC-approved RI (including groundwater sampling for emerging contaminants – 1,4-dioxane and PFAS).
- Field manager for an affordable housing redevelopment NYSDEC BCP site in Bronx, New York. The site was formally used as a juvenile detention center. This project included a due diligence environmental investigation; remedial investigations (soil, groundwater, and soil vapor); site-wide *in situ* waste characterization sampling program; implementation of a Remedial Action Work Plan; the removal and proper closure of multiple USTs; the management of soil excavations; and the collection of over 130 confirmation and documentation endpoint soil samples.
- Field manager for an ecological survey of a phytoremediation plot at a site in Lowland, Tennessee. The phytoremediation plot was designed to remediate an onsite landfill associated with the former use of the property. The ecological survey included the geographical surveying of approximately 5,000 trees using a global positioning system (GPS) device and a survey of the ecological health of the plot, including insect damage, fungus, vegetation stress, and other diseases, when present.
- Project manager for a potential redevelopment site located in Staten Island. Responsibilities included the implementation of components of a Phase I ESA; preparation of a Phase I ESA Report; design, implementation, and management of a Phase II ESA including soil and groundwater sample collection; and preparation of a Phase II ESA Report summarizing the past use of the site and the results of the investigation in support of the expedited acquisition of the site.
- Project manager / field manager for a potential NYSDEC BCP site located in the Greenpoint neighborhood of Brooklyn, New York. Responsibilities included the implementation of a Phase II ESA, including soil, groundwater, soil vapor (sub-slab and vapor pin), and ash sample collection; preparation of a Phase II ESA Report summarizing the results of the investigation; and preparation of the NYSDEC BCP application documents.
- Field manager for a redevelopment project located in East Orange, New Jersey. Responsibilities included the design of an *in situ* concrete sampling plan in support of the planned demolition and responsible disposal of the onsite buildings; implementation of the concrete sampling plan and collection of concrete samples from each of the seven building clusters across the site for SVOCs and PCBs; the collection of delineation concrete samples when necessary to limit areas of elevated contaminant concentration; and proper offsite disposal of investigation derived waste (IDW).

Dana M. Hignell
Senior Engineer

TECHNICAL SPECIALTIES

Engineering services for the investigation, design, construction, and operation and maintenance of remedial systems for the treatment of contaminated soil, sediment, and groundwater. Remedial designs have included excavation, in-situ groundwater remediation, groundwater pump and treat systems, air sparging with soil vapor extraction, vapor barriers and sub-slab depressurization systems, and landfill soil cover systems.

EXPERIENCE SUMMARY

Over nineteen years of experience: Staff, Project, and Senior Engineer with Roux Associates, Inc.

CREDENTIALS

B.S., Chemical Engineering, Cornell University, 2000.
OSHA 40 hour Health & Safety Course, 2000.
OSHA 8-hour Health & Safety Refresher Course, 2000-Present.

KEY PROJECTS

- Senior Engineer for the design and start up of a soil vapor extraction (SVE) and air sparge (AS) system at an active gasoline station in Staten Island, New York. The system was installed to address soil and groundwater contaminants and consists of 17 vertical SVE wells and 10 AS wells. The recovered soil vapor is treated by catalytic oxidation before being discharged. Over 1,200 pounds of hydrocarbon have been recovered since system start up.

- Senior Engineer for the design of in-situ groundwater remediation to treat chlorinated volatile organic compounds (CVOCs) at a former dry cleaner in Bronx, New York. In-situ chemical oxidation (ISCO) was selected as the groundwater remedy, with injections completed over a half an acre of property. The ISCO remedy was successful and allowed for redevelopment of the property within the required schedule.

- Senior Engineer for the design and implementation of a passive product-recovery system using horizontal recovery wells at a former bus garage in Newark, New Jersey. The remedial action also included excavation and offsite disposal of approximately 7,000 tons of petroleum contaminated soil, and in-situ chemical oxidation to treat residual soil and groundwater contamination.

- Senior Engineering managing the investigation, design and implementation of product-recovery skimming systems for a former petroleum refinery in Queens, New York. Over 100,000 gallons of product has been recovered to date.

- Senior Engineer for the design of a sub-slab depressurization system with vapor barrier for the construction of a 19-story residential building in Brooklyn, New York.

- Senior Engineer for the investigation, design and implementation of a soil remediation project at a Former Oil Terminal in Sag Harbor, New York. The remedy completed includes excavation and offsite disposal of approximately 2,000 tons of petroleum contaminated soil in an active roadway surrounded by underground utilities.

- Senior Engineer for the investigation, design, and implementation of a soil remediation project at a 4 acre Former Oil Terminal in Cold Spring Harbor, New York. The remedy completed includes excavation and offsite disposal of approximately 20,000 tons of petroleum contaminated and/or hazardous lead contaminated soil in accordance with the future use of the site under an Environmental Easement. Additional activities completed at the site included asbestos remediation followed by building demolition, UST removal, and cesspool remediation.

- Project Engineer for the complete design for a 9-acre landfill in Rensselaer, New York as part of the NYSDEC Voluntary Cleanup Program. The design was in accordance with the future use of the Site as a landfill with an integrated wildlife habitat vegetative cap and included hot spot soil excavation and installation of a vegetative cap.

- Project Engineer for the design of a soil and groundwater remediation system for a Former Oil Terminal in Oceanside, New York. A risk based remedial approach that called for the remediation of "hot spot" source area soils, and mass-reduction of VOCs in groundwater was successfully utilized for the Site. To address the soil contamination in the source areas, "hot spot" soil excavation was completed. A groundwater pump and treat system was designed, constructed, and continues to be operated and maintained to address the VOC contaminants in groundwater. The system consists of seven recovery wells, an oil/water separator, and a packed column air stripping tower. Over 11 million gallons of groundwater have been recovered and treated.

- Project Engineer for the design and startup of a soil vapor extraction (SVE) and air sparge (AS) system at an 11-acre active Oil Terminal in Glenwood Landing, New York. The system was installed to address soil and groundwater contaminants and consists of four horizontal SVE wells and 8 AS wells. The recovered soil vapor is treated by carbon units before being discharged. Approximately 12,000 pounds of hydrocarbon have been recovered since system start up.

- Project Engineer for the design and startup of a soil vapor extraction (SVE) and air sparge (AS) system at an 11-acre active Oil Terminal in Inwood, New York. The system was installed to address soil and groundwater contaminants and consists of 4 vertical SVE wells and six AS wells. The recovered soil vapor is treated by carbon units before being discharged. Approximately 32,000 pounds of hydrocarbon have been recovered since system start up.

Operation and Maintenance (O&M) Experience:

- Project Engineer responsible for the O&M and monitoring of a SVE system and a dual-pump, product recovery system at an active Oil Terminal in Inwood, New York. O&M activities included system operation and maintenance, performance monitoring, and preparation of quarterly status reports for submission to the NYSDEC. The SVE system consists of 5 SVE wells and was designed, constructed, operated and maintained for a period of approximately 6 years. The SVE system was permanently shut down and this area of the Site is currently in the post-remediation monitoring phase. The dual-pump system, including groundwater and product recovery and packed column air stripping towers, is currently still in operation.
- Project Engineer responsible for the operation and maintenance of soil and groundwater remediation systems for an active Oil Terminal in Glenwood Landing, New York. A groundwater pump and treat system, consisting of 1 recovery well, two packed column air stripping towers, bag filters and granular activated carbon units, has been in operation at the Site to address VOC contaminants in groundwater. In addition, a SVE/AS system, previously installed, was upgraded to further address soil and groundwater contaminants at the Site boundaries. The SVE system consisted of vertical wells in an area of shallow groundwater. The system was upgraded with seven horizontal wells and an additional five AS wells were installed. Following an on-site diesel spill of approximately 5,000 gallons in 2005, free-product recovery efforts were implemented, including removal of saturated soils and installation of a free-product recovery system.
- Staff Engineer responsible for the O&M and monitoring of a SVE/AS system for nationwide distribution center in Brooklyn, New York as part of the NYSDEC Voluntary Cleanup Program. O&M activities included system operation and maintenance, performance monitoring, soil gas monitoring, quarterly monitoring, and preparation of quarterly and annual status reports for submission to the NYSDEC. The SVE and AS system consists of 8 SVE wells and 17 AS wells and was designed, constructed, operated and maintained for a period of approximately 3 years. The SVE and AS system is permanently shut down and the Site is currently in the post-remediation monitoring phase.
- Staff Engineer responsible for the O&M of a 430 gpm, dual-pump, product recovery system in Greenpoint, Brooklyn, New York. Processes and system maintained include dual-pump ground-water and product recovery, low profile air strippers and a catalytic oxidation unit. The Site encompasses one of the nation's largest petroleum releases (18 million gallons).

UST Experience:

- Project Engineer for the management of the excavation and removal of a 10,000-gallon UST and four ASTs ranging from 284,000-gallon capacity to 976,000-gallon capacity at a former Oil Terminal in Cold Spring Harbor, New York. The scope of work entailed preparation of a UST and AST closure work plan, project management of the field work, post excavation and tank footprint sampling and preparation of a UST and AST Closure Report.
- Project Engineer for the excavation oversight of a 2,000-gallon heating oil UST at an active Oil Terminal in Glenwood Landing, New York. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal, cleaning, and disposal of the USTs and preparation of a Closure Report.
- Project Engineer for the excavation oversight of a 2,000-gallon heating oil UST at an active Oil Terminal in Inwood, New York. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal, cleaning, and disposal of the USTs and preparation of a Closure Report. Also included was the management and field oversight of the closure of an in ground oil/water separator at an active Oil Terminal Inwood, New York. The scope of work entailed preparation of an oil/water separator closure work plan, project management of the field work, excavation of petroleum contaminated soils associated with the separator, post-excavation sampling, and preparation of an Oil/Water Separator Closure Report.
- Staff Engineer for the excavation oversight of three 8,000 gallon USTs, two pump islands and three hydraulic lifts and all associated piping at a former service station in Norwalk, Connecticut. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal, cleaning, and disposal of the USTs, and preparation of a Closure Report.
- Staff Engineer for the excavation oversight of three 8,000 gallon USTs, two pump islands and all associated piping at a former service station in Hartford, Connecticut. Field oversight included post-excavation and waste characterization soil sampling, health and safety monitoring, supervision during the removal, cleaning, and disposal of the USTs and preparation of

a Closure Report.

Soil and Groundwater Remediation:

- Project Engineer for the design of soil remediation at an active Oil Terminal in Stamford, Connecticut to remove contaminated soils following a 30,000-gallon petroleum spill in 2006. The remediation included excavation of approximately 1,000 cubic yards of petroleum-impacted soil with post-excavation sampling.
- Staff Engineer responsible for construction management of remediation of a former major pharmaceutical plant located in Hicksville, New York as part of the State Superfund Program. The project consisted of the excavation of non-hazardous soil from five on-site drywells and a former waste disposal area, implementation of a community air monitoring plan, coordination with the Long Island Rail Road (LIRR) for work performed within the LIRR's right of way, steel sheeting installation and removal, backfilling, monitoring well abandonment and replacement, transportation and disposal of 3,300 tons of VOC, SVOC and metal contaminated soil, and restoration of approximately 9,800 square feet of asphalt. A 7-foot diameter steel caisson was used to support the deeper excavation required at the invert of two drywells. This innovative approach saved the client approximately $50,000 in costs that would have been incurred by using a traditional steel sheeting support system to protect the on-site commercial building.

Stormwater:

- Project Engineer for the design and construction management of a stormwater drainage upgrade project for the parking lot of a former manufacturing facility (costume jewelry and then surgical needles) located in Queens Village, New York. The stormwater drainage system consisted of multiple catch basins, a new drain and curb, and all associated piping.
- Project Engineer for the design and construction of two stormwater management ponds and swales for a former landfill in Rensselaer, New York. The ponds and swales were constructed as part of the landfill cap project to direct stormwater to existing catch basins, allow stormwater overflow control and to enhance the wildlife habitat.

JUDY V. HARRY

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North Creek, NY 12853

Occupation:	Data Validator/Environmental Technical Consultant
Years Experience:	41
Education:	B.S., Chemistry, Magna cum laude, 1976, Phi Beta Kappa
Certifications:	New York State Woman-Owned Business Enterprise (WBE)

Relevant Work History:

Data Validation Services: September 1989 - present

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

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

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

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

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

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

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

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

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

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

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

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

Adirondack Environmental Services: June 1987 - August 1989

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

CompuChem Laboratories: May 1982 - January 1987

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

Research Triangle Institute: December 1979 - May 1982

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

Guardsman Chemical Company: February 1977 - November 1979

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

Almay Cosmetics: May 1976 - December 1976

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

Publication

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

ATTACHMENT 2

NYSDEC PFAS Guidance

NEW YORK STATE OF OPPORTUNITY. | Department of Environmental Conservation

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

Under NYSDEC's Part 375 Remedial Programs

January 2021

www.dec.ny.gov

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January 2021

ERRATA SHEET for

SAMPLING, ANALYSIS, AND ASSESSMENT OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) Under NYSDEC's Part 375 Remedial Programs Issued January 17, 2020

Citation and Page Number	Current Text	Corrected Text	Date
Title of Appendix I, page 32	Appendix H	Appendix I	2/25/2020
Document Cover, page 1	Guidelines for Sampling and Analysis of PFAS	Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs	9/15/2020
Routine Analysis, page 9	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1 or ISO 25101."	"However, laboratories analyzing environmental samples…PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533."	9/15/2020
Additional Analysis, page 9, new paragraph regarding soil parameters	None	"In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (EPA Method 9060), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils."	9/15/2020
Data Assessment and Application to Site Cleanup Page 10	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFAS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Target levels for cleanup of PFAS in other media, including biota and sediment, have not yet been established by the DEC.	Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Water Sample Results Page 10	PFAS should be further assessed and considered as a potential contaminant of concern in groundwater or surface water (…) If PFAS are identified as a contaminant of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water (…) If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.	9/15/2020
Soil Sample Results, page 10	"The extent of soil contamination for purposes of delineation and remedy selection should be determined by having certain soil samples tested by Synthetic Precipitation Leaching Procedure (SPLP) and the leachate analyzed for PFAS. Soil exhibiting SPLP results above 70 ppt for either PFOA or PFOS (individually or combined) are to be evaluated during the cleanup phase."	"Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values. " [Interim SCO Table] "PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP. As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf. "	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Testing for Imported Soil Page 11	Soil imported to a site for use in a soil cap, soil cover, or as backfill is to be tested for PFAS in general conformance with DER-10, Section 5.4(e) for the PFAS Analyte List (Appendix F) using the analytical procedures discussed below and the criteria in DER-10 associated with SVOCs. If PFOA or PFOS is detected in any sample at or above 1 µg/kg, then soil should be tested by SPLP and the leachate analyzed for PFAS. If the SPLP results exceed 10 ppt for either PFOA or PFOS (individually) then the source of backfill should be rejected, unless a site-specific exemption is provided by DER. SPLP leachate criteria is based on the Maximum Contaminant Levels proposed for drinking water by New York State's Department of Health, this value may be updated based on future Federal or State promulgated regulatory standards. Remedial parties have the option of analyzing samples concurrently for both PFAS in soil and in the SPLP leachate to minimize project delays. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable. PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.	9/15/2020

Citation and Page Number	Current Text	Corrected Text	Date
Footnotes	None	[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances. [2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the soil cleanup objective for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).	9/15/2020
Additional Analysis, page 9	In cases… soil parameters, such as Total Organic Carbon (EPA Method 9060), soil…	In cases… soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil…	1/8/2021
Appendix A, General Guidelines, fourth bullet	List the ELAP-approved lab(s) to be used for analysis of samples	List the ELAP- certified lab(s) to be used for analysis of samples	1/8/2021
Appendix E, Laboratory Analysis and Containers	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by ISO Method 25101.	Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101	1/8/2021

Sampling, Analysis, and Assessment of Per- and Polyfluoroalkyl Substances (PFAS) Under NYSDEC's Part 375 Remedial Programs

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Objective

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) performs or oversees sampling of environmental media and subsequent analysis of PFAS as part of remedial programs implemented under 6 NYCRR Part 375. To ensure consistency in sampling, analysis, reporting, and assessment of PFAS, DER has developed this document which summarizes currently accepted procedures and updates previous DER technical guidance pertaining to PFAS.

Applicability

All work plans submitted to DEC pursuant to one of the remedial programs under Part 375 shall include PFAS sampling and analysis procedures that conform to the guidelines provided herein.

As part of a site investigation or remedial action compliance program, whenever samples of potentially affected media are collected and analyzed for the standard Target Analyte List/Target Compound List (TAL/TCL), PFAS analysis should also be performed. Potentially affected media can include soil, groundwater, surface water, and sediment. Based upon the potential for biota to be affected, biota sampling and analysis for PFAS may also be warranted as determined pursuant to a Fish and Wildlife Impact Analysis. Soil vapor sampling for PFAS is not required.

Field Sampling Procedures

DER-10 specifies technical guidance applicable to DER's remedial programs. Given the prevalence and use of PFAS, DER has developed "best management practices" specific to sampling for PFAS. As specified in DER-10 Chapter 2, quality assurance procedures are to be submitted with investigation work plans. Typically, these procedures are incorporated into a work plan, or submitted as a stand-alone document (e.g., a Quality Assurance Project Plan). Quality assurance guidelines for PFAS are listed in Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS.

Field sampling for PFAS performed under DER remedial programs should follow the appropriate procedures outlined for soils, sediments or other solids (Appendix B), non-potable groundwater (Appendix C), surface water (Appendix D), public or private water supply wells (Appendix E), and fish tissue (Appendix F).

QA/QC samples (e.g. duplicates, MS/MSD) should be collected as specified in DER-10, Section 2.3(c). For sampling equipment coming in contact with aqueous samples only, rinsate or equipment blanks should be collected. Equipment blanks should be collected at a minimum frequency of one per day per site or one per twenty samples, whichever is more frequent.

Analysis and Reporting

As of October 2020, the United States Environmental Protection Agency (EPA) does not have a validated method for analysis of PFAS for media commonly analyzed under DER remedial programs (non-potable waters, solids). DER has developed the following guidelines to ensure consistency in analysis and reporting of PFAS.

The investigation work plan should describe analysis and reporting procedures, including laboratory analytical procedures for the methods discussed below. As specified in DER-10 Section 2.2, laboratories should provide a full Category B deliverable. In addition, a Data Usability Summary Report (DUSR) should be prepared by an independent, third party data validator. Electronic data submissions should meet the requirements provided at: https://www.dec.ny.gov/chemical/62440.html.

DER has developed a *PFAS Analyte List* (Appendix F) for remedial programs to understand the nature of contamination at sites. It is expected that reported results for PFAS will include, at a minimum, all the compounds listed. If lab and/or matrix specific issues are encountered for any analytes, the DER project manager, in consultation with the DER chemist, will make case-by-case decisions as to whether certain analytes may be temporarily or permanently discontinued from analysis at each site. As with other contaminants that are analyzed for at a site, the *PFAS Analyte List* may be refined for future sampling events based on investigative findings.

Routine Analysis

Currently, New York State Department of Health’s Environmental Laboratory Approval Program (ELAP) does not offer certification for PFAS in matrices other than finished drinking water. However, laboratories analyzing environmental samples for PFAS (e.g., soil, sediments, and groundwater) under DER’s Part 375 remedial programs need to hold ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, ISO 25101, or Method 533. Laboratories should adhere to the guidelines and criteria set forth in the DER’s laboratory guidelines for PFAS in non-potable water and solids (Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids). Data review guidelines were developed by DER to ensure data comparability and usability (Appendix H - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids).

LC-MS/MS analysis for PFAS using methodologies based on EPA Method 537.1 is the procedure to use for environmental samples. Isotope dilution techniques should be utilized for the analysis of PFAS in all media. Reporting limits for PFOA and PFOS in aqueous samples should not exceed 2 ng/L. Reporting limits for PFOA and PFOS in solid samples should not exceed 0.5 µg/kg. Reporting limits for all other PFAS in aqueous and solid media should be as close to these limits as possible. If laboratories indicate that they are not able to achieve these reporting limits for the entire *PFAS Analyte List*, site-specific decisions regarding acceptance of elevated reporting limits for specific PFAS can be made by the DER project manager in consultation with the DER chemist.

Additional Analysis

Additional laboratory methods for analysis of PFAS may be warranted at a site, such as the Synthetic Precipitation Leaching Procedure (SPLP) and Total Oxidizable Precursor Assay (TOP Assay).

In cases where site-specific cleanup objectives for PFOA and PFOS are to be assessed, soil parameters, such as Total Organic Carbon (Lloyd Kahn), soil pH (EPA Method 9045), clay content (percent), and cation exchange capacity (EPA Method 9081), should be included in the analysis to help evaluate factors affecting the leachability of PFAS in site soils.

SPLP is a technique used to determine the mobility of chemicals in liquids, soils and wastes, and may be useful in determining the need for addressing PFAS-containing material as part of the remedy. SPLP by EPA Method 1312 should be used unless otherwise specified by the DER project manager in consultation with the DER chemist.

Impacted materials can be made up of PFAS that are not analyzable by routine analytical methodology. A TOP Assay can be utilized to conceptualize the amount and type of oxidizable PFAS which could be liberated in the environment, which approximates the maximum concentration of perfluoroalkyl substances that could be generated if all polyfluoroalkyl substances were oxidized. For example, some polyfluoroalkyl substances may degrade or transform to form perfluoroalkyl substances (such as PFOA or PFOS), resulting in an increase in perfluoroalkyl substance concentrations as contaminated groundwater moves away from a source. The TOP Assay converts, through oxidation, polyfluoroalkyl substances (precursors) into perfluoroalkyl substances that can be detected by routine analytical methodology.[1]

Commercial laboratories have adopted methods which allow for the quantification of targeted PFAS in air and biota. The EPA's Office of Research and Development (ORD) is currently developing methods which allow for air emissions characterization of PFAS, including both targeted and non-targeted analysis of PFAS. Consult with the DER project manager and the DER chemist for assistance on analyzing biota/tissue and air samples.

Data Assessment and Application to Site Cleanup

Until such time as Ambient Water Quality Standards (AWQS) and Soil Cleanup Objectives (SCOs) for PFOA and PFOS are published, the extent of contaminated media potentially subject to remediation should be determined on a case-by-case basis using the procedures discussed below and the criteria in DER-10. Preliminary target levels for cleanup of PFOA and PFOS in other media, including biota and sediment, have not yet been established by the DEC.

Water Sample Results

PFOA and PFOS should be further assessed and considered as potential contaminants of concern in groundwater or surface water if PFOA or PFOS is detected in any water sample at or above 10 ng/L (ppt) and is determined to be attributable to the site, either by a comparison of upgradient and downgradient levels, or the presence of soil source areas, as defined below. In addition, further assessment of water may be warranted if either of the following screening levels are met:

a. any other individual PFAS (not PFOA or PFOS) is detected in water at or above 100 ng/L; or
b. total concentration of PFAS (including PFOA and PFOS) is detected in water at or above 500 ng/L

If PFOA and/or PFOS are identified as contaminants of concern for a site, they should be assessed as part of the remedy selection process in accordance with Part 375 and DER-10.

Soil Sample Results

Soil cleanup objectives for PFOA and PFOS will be proposed in an upcoming revision to 6 NYCRR Part 375-6. Until SCOs are in effect, the following are to be used as guidance values.

Guidance Values for Anticipated Site Use	**PFOA (ppb)**	**PFOS (ppb)**
Unrestricted	0.66	0.88
Residential	6.6	8.8
Restricted Residential	33	44
Commercial	500	440
Industrial	600	440
Protection of Groundwater[2]	1.1	3.7

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[1] TOP Assay analysis of highly contaminated samples, such as those from an AFFF (aqueous film-forming foam) site, can result in incomplete oxidation of the samples and an underestimation of the total perfluoroalkyl substances.

[2] The movement of PFAS in the environment is being aggressively researched at this time; that research will eventually result in more accurate models for the behaviors of these chemicals. In the meantime, DEC has calculated the guidance value for the protection of groundwater using the same procedure used for all other chemicals, as described in Section 7.7 of the Technical Support Document (http://www.dec.ny.gov/docs/remediation_hudson_pdf/techsuppdoc.pdf).

PFOA and PFOS results for soil are to be compared against the guidance values listed above. These guidance values are to be used in determining whether PFOA and PFOS are contaminants of concern for the site and for determining remedial action objectives and cleanup requirements. Site-specific remedial objectives for protection of groundwater can also be presented for evaluation by DEC. Development of site-specific remedial objectives for protection of groundwater will require analysis of additional soil parameters relating to leachability. These additional analyses can include any or all the parameters listed above (soil pH, cation exchange capacity, etc.) and/or use of SPLP.

As the understanding of PFAS transport improves, DEC welcomes proposals for site-specific remedial objectives for protection of groundwater. DEC will expect that those may be dependent on additional factors including soil pH, aqueous pH, % organic carbon, % Sand/Silt/Clay, soil cations: K, Ca, Mg, Na, Fe, Al, cation exchange capacity, and anion exchange capacity. Site-specific remedial objectives should also consider the dilution attenuation factor (DAF). The NJDEP publication on DAF can be used as a reference: https://www.nj.gov/dep/srp/guidance/rs/daf.pdf.

Testing for Imported Soil

Testing for PFAS should be included any time a full TAL/TCL analyte list is required. Results for PFOA and PFOS should be compared to the applicable guidance values. If PFOA or PFOS is detected in any sample at or above the guidance values then the source of backfill should be rejected, unless a site-specific exemption is provided by DER based on SPLP testing, for example. If the concentrations of PFOA and PFOS in leachate are at or above 10 ppt (the Maximum Contaminant Levels established for drinking water by the New York State Department of Health), then the soil is not acceptable.

PFOA, PFOS and 1,4-dioxane are all considered semi-volatile compounds, so composite samples are appropriate for these compounds when sampling in accordance with DER-10, Table 5.4(e)10. Category B deliverables should be submitted for backfill samples, though a DUSR is not required.

Appendix A - Quality Assurance Project Plan (QAPP) Guidelines for PFAS

The following guidelines (general and PFAS-specific) can be used to assist with the development of a QAPP for projects within DER involving sampling and analysis of PFAS.

General Guidelines in Accordance with DER-10

- Document/work plan section title – Quality Assurance Project Plan
- Summarize project scope, goals, and objectives
- Provide project organization including names and resumes of the project manager, Quality Assurance Officer (QAO), field staff, and Data Validator
    - The QAO should not have another position on the project, such as project or task manager, that involves project productivity or profitability as a job performance criterion
- List the ELAP certified lab(s) to be used for analysis of samples
- Include a site map showing sample locations
- Provide detailed sampling procedures for each matrix
- Include Data Quality Usability Objectives
- List equipment decontamination procedures
- Include an “Analytical Methods/Quality Assurance Summary Table” specifying:
    - Matrix type
    - Number or frequency of samples to be collected per matrix
    - Number of field and trip blanks per matrix
    - Analytical parameters to be measured per matrix
    - Analytical methods to be used per matrix with minimum reporting limits
    - Number and type of matrix spike and matrix spike duplicate samples to be collected
    - Number and type of duplicate samples to be collected
    - Sample preservation to be used per analytical method and sample matrix
    - Sample container volume and type to be used per analytical method and sample matrix
    - Sample holding time to be used per analytical method and sample matrix
- Specify Category B laboratory data deliverables and preparation of a DUSR

Specific Guidelines for PFAS

- Include in the text that sampling for PFAS will take place
- Include in the text that PFAS will be analyzed by LC-MS/MS for PFAS using methodologies based on EPA Method 537.1
- Include the list of PFAS compounds to be analyzed (*PFAS Analyte List*)
- Include the laboratory SOP for PFAS analysis
- List the minimum method-achievable Reporting Limits for PFAS
    - Reporting Limits should be less than or equal to:
        - Aqueous – 2 ng/L (ppt)
        - Solids – 0.5 µg/kg (ppb)
- Include the laboratory Method Detection Limits for the PFAS compounds to be analyzed
- Laboratory should have ELAP certification for PFOA and PFOS in drinking water by EPA Method 537, 537.1, EPA Method 533, or ISO 25101
- Include detailed sampling procedures
    - Precautions to be taken
    - Pump and equipment types
    - Decontamination procedures
    - Approved materials only to be used
- Specify that regular ice only will be used for sample shipment
- Specify that equipment blanks should be collected at a minimum frequency of 1 per day per site for each matrix

Appendix B - Sampling Protocols for PFAS in Soils, Sediments and Solids

General

The objective of this protocol is to give general guidelines for the collection of soil, sediment and other solid samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Containers

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in to contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel spoon
- stainless steel bowl
- steel hand auger or shovel without any coatings

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Sampling is often conducted in areas where a vegetative turf has been established. In these cases, a pre-cleaned trowel or shovel should be used to carefully remove the turf so that it may be replaced at the conclusion of sampling. Surface soil samples (e.g. 0 to 6 inches below surface) should then be collected using a pre-cleaned, stainless steel spoon. Shallow subsurface soil samples (e.g. 6 to ~36 inches below surface) may be collected by digging a hole using a pre-cleaned hand auger or shovel. When the desired subsurface depth is reached, a pre-cleaned hand auger or spoon shall be used to obtain the sample.

When the sample is obtained, it should be deposited into a stainless steel bowl for mixing prior to filling the sample containers. The soil should be placed directly into the bowl and mixed thoroughly by rolling the material into the middle until the material is homogenized. At this point the material within the bowl can be placed into the laboratory provided container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A soil log or sample log shall document the location of the sample/borehole, depth of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix C - Sampling Protocols for PFAS in Monitoring Wells

General

The objective of this protocol is to give general guidelines for the collection of groundwater samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including plumbers tape and sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel inertia pump with HDPE tubing
- peristaltic pump equipped with HDPE tubing and silicone tubing
- stainless steel bailer with stainless steel ball
- bladder pump (identified as PFAS-free) with HDPE tubing

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Monitoring wells should be purged in accordance with the sampling procedure (standard/volume purge or low flow purge) identified in the site work plan, which will determine the appropriate time to collect the sample. If sampling using standard purge techniques, additional purging may be needed to reduce turbidity levels, so samples contain a limited amount of sediment within the sample containers. Sample containers that contain sediment may cause issues at the laboratory, which may result in elevated reporting limits and other issues during the sample preparation that can compromise data usability. Sampling personnel should don new nitrile gloves prior to sample collection due to the potential to contact PFAS containing items (not related to the sampling equipment) during the purging activities.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Additional equipment blank samples may be collected to assess other equipment that is utilized at the monitoring well
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A purge log shall document the location of the sample, sampling equipment, groundwater parameters, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix D - Sampling Protocols for PFAS in Surface Water

General

The objective of this protocol is to give general guidelines for the collection of surface water samples for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Samples collected using this protocol are intended to be analyzed for PFAS using methodologies based on EPA Method 537.1.

The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include: stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation’s Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials including sample bottle cap liners with a PTFE layer.

A list of acceptable equipment is provided below, but other equipment may be considered appropriate based on sampling conditions.

- stainless steel cup

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Where conditions permit, (e.g. creek or pond) sampling devices (e.g. stainless steel cup) should be rinsed with site medium to be sampled prior to collection of the sample. At this point the sample can be collected and poured into the sample container.

If site conditions permit, samples can be collected directly into the laboratory container.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- Collect one equipment blank per day per site and minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers
- Request appropriate data deliverable (Category B) and an electronic data deliverable

Documentation

A sample log shall document the location of the sample, sampling equipment, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate. Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appropriate rain gear (PVC, polyurethane, or rubber rain gear are acceptable), bug spray, and sunscreen should be used that does not contain PFAS. Well washed cotton coveralls may be used as an alternative to bug spray and/or sunscreen.

PPE that contains PFAS is acceptable when site conditions warrant additional protection for the samplers and no other materials can be used to be protective. Documentation of such use should be provided in the field notes.

Appendix E - Sampling Protocols for PFAS in Private Water Supply Wells

General

The objective of this protocol is to give general guidelines for the collection of water samples from private water supply wells (with a functioning pump) for PFAS analysis. The sampling procedure used should be consistent with Sampling Guidelines and Protocols – Technological Background and Quality Control/Quality Assurance for NYS DEC Spill Response Program – March 1991 (http://www.dec.ny.gov/docs/remediation_hudson_pdf/sgpsect5.pdf), with the following limitations.

Laboratory Analysis and Container

Drinking water samples collected using this protocol are intended to be analyzed for PFAS by EPA Method 537, 537.1, 533, or ISO Method 25101. The preferred material for containers is high density polyethylene (HDPE). Pre-cleaned sample containers, coolers, sample labels, and a chain of custody form will be provided by the laboratory.

Equipment

Acceptable materials for sampling include stainless steel, HDPE, PVC, silicone, acetate, and polypropylene. Additional materials may be acceptable if pre-approved by New York State Department of Environmental Conservation's Division of Environmental Remediation.

No sampling equipment components or sample containers should come in contact with aluminum foil, low density polyethylene, glass, or polytetrafluoroethylene (PTFE, Teflon™) materials (e.g. plumbers tape), including sample bottle cap liners with a PTFE layer.

Equipment Decontamination

Standard two step decontamination using detergent (Alconox is acceptable) and clean, PFAS-free water will be performed for sampling equipment. All sources of water used for equipment decontamination should be verified in advance to be PFAS-free through laboratory analysis or certification.

Sampling Techniques

Locate and assess the pressure tank and determine if any filter units are present within the building. Establish the sample location as close to the well pump as possible, which is typically the spigot at the pressure tank. Ensure sampling equipment is kept clean during sampling as access to the pressure tank spigot, which is likely located close to the ground, may be obstructed and may hinder sample collection.

Prior to sampling, a faucet downstream of the pressure tank (e.g., washroom sink) should be run until the well pump comes on and a decrease in water temperature is noted which indicates that the water is coming from the well. If the homeowner is amenable, staff should run the water longer to purge the well (15+ minutes) to provide a sample representative of the water in the formation rather than standing water in the well and piping system including the pressure tank. At this point a new pair of nitrile gloves should be donned and the sample can be collected from the sample point at the pressure tank.

Sample Identification and Logging

A label shall be attached to each sample container with a unique identification. Each sample shall be included on the chain of custody (COC).

Quality Assurance/Quality Control

- Immediately place samples in a cooler maintained at 4 ± 2º Celsius using ice
- Collect one field duplicate for every sample batch, minimum 1 duplicate per 20 samples. The duplicate shall consist of an additional sample at a given location
- Collect one matrix spike / matrix spike duplicate (MS/MSD) for every sample batch, minimum 1 MS/MSD per 20 samples. The MS/MSD shall consist of an additional two samples at a given location and identified on the COC
- If equipment was used, collect one equipment blank per day per site and a minimum 1 equipment blank per 20 samples. The equipment blank shall test the new and decontaminated sampling equipment utilized to obtain a sample for residual PFAS contamination. This sample is obtained by using laboratory provided PFAS-free water and passing the water over or through the sampling device and into laboratory provided sample containers.
- A field reagent blank (FRB) should be collected at a rate of one per 20 samples. The lab will provide a FRB bottle containing PFAS free water and one empty FRB bottle. In the field, pour the water from the one bottle into the empty FRB bottle and label appropriately.
- Request appropriate data deliverable (Category B) and an electronic data deliverable
- For sampling events where multiple private wells (homes or sites) are to be sampled per day, it is acceptable to collect QC samples at a rate of one per 20 across multiple sites or days.

Documentation

A sample log shall document the location of the private well, sample point location, owner contact information, sampling equipment, purge duration, duplicate sample, visual description of the material, and any other observations or notes determined to be appropriate and available (e.g. well construction, pump type and location, yield, installation date). Additionally, care should be performed to limit contact with PFAS containing materials (e.g. waterproof field books, food packaging) during the sampling process.

Personal Protection Equipment (PPE)

For most sampling Level D PPE is anticipated to be appropriate. The sampler should wear nitrile gloves while conducting field work and handling sample containers.

Field staff shall consider the clothing to be worn during sampling activities. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials should be avoided. All clothing worn by sampling personnel should have been laundered multiple times.

Appendix F - Sampling Protocols for PFAS in Fish

This appendix contains a copy of the latest guidelines developed by the Division of Fish and Wildlife (DFW) entitled "General Fish Handling Procedures for Contaminant Analysis" (Ver. 8).

Procedure Name: General Fish Handling Procedures for Contaminant Analysis

Number: FW-005

Purpose: This procedure describes data collection, fish processing and delivery of fish collected for contaminant monitoring. It contains the chain of custody and collection record forms that should be used for the collections.

Organization: Environmental Monitoring Section
Bureau of Ecosystem Health
Division of Fish and Wildlife (DFW)
New York State Department of Environmental Conservation (NYSDEC)
625 Broadway
Albany, New York 12233-4756

Version: 8

Previous Version Date: 21 March 2018

Summary of Changes to this Version: Updated bureau name to Bureau of Ecosystem Health. Added direction to list the names of all field crew on the collection record. Minor formatting changes on chain of custody and collection records.

Originator or Revised by: Wayne Richter, Jesse Becker

Date: 26 April 2019

Quality Assurance Officer and Approval Date: Jesse Becker, 26 April 2019

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

GENERAL FISH HANDLING PROCEDURES FOR CONTAMINANT ANALYSES

A. Original copies of all continuity of evidence (i.e., Chain of Custody) and collection record forms must accompany delivery of fish to the lab. A copy shall be directed to the Project Leader or as appropriate, Wayne Richter. All necessary forms will be supplied by the Bureau of Ecosystem Health. Because some samples may be used in legal cases, it is critical that each section is filled out completely. Each Chain of Custody form has three main sections:

   1. The top box is to be filled out **and signed** by the person responsible for the fish collection (e.g., crew leader, field biologist, researcher). This person is responsible for delivery of the samples to DEC facilities or personnel (e.g., regional office or biologist).

   2. The second section is to be filled out **and signed** by the person responsible for the collections while being stored at DEC, before delivery to the analytical lab. This may be the same person as in (1), but it is still required that they complete the section. Also important is the **range of identification numbers** (i.e., tag numbers) included in the sample batch.

   3. Finally, the bottom box is to record any transfers between DEC personnel and facilities. Each subsequent transfer should be **identified, signed, and dated**, until laboratory personnel take possession of the fish.

B. The following data are required on each **Fish Collection Record** form:

   1. Project and Site Name.

   2. DEC Region.

   3. All personnel (and affiliation) involved in the collection.

   4. Method of collection (gill net, hook and line, etc.)

   5. Preservation Method.

C. The following data are to be taken on each fish collected and recorded on the **Fish Collection Record** form:

   1. Tag number - Each specimen is to be individually jaw tagged at time of collection with a unique number. Make sure the tag is turned out so that the number can be read without opening the bag. Use tags in sequential order. For small fish or composite samples place the tag inside the bag with the samples. The Bureau of Ecosystem Health can supply the tags.

   2. Species identification (please be explicit enough to enable assigning genus and species). Group fish by species when processing.

   3. Date collected.

   4. Sample location (waterway and nearest prominent identifiable landmark).

   5. Total length (nearest mm or smallest sub-unit on measuring instrument) and weight (nearest g or

smallest sub-unit of weight on weighing instrument). Take all measures as soon as possible with calibrated, protected instruments (e.g. from wind and upsets) and prior to freezing.

6. Sex - fish may be cut enough to allow sexing or other internal investigation, but do not eviscerate. Make any incision on the right side of the belly flap or exactly down the midline so that a left-side fillet can be removed.

D. General data collection recommendations:

1. It is helpful to use an ID or tag number that will be unique. It is best to use metal striped bass or other uniquely numbered metal tags. If uniquely numbered tags are unavailable, values based on the region, water body and year are likely to be unique: for example, R7CAY11001 for Region 7, Cayuga Lake, 2011, fish 1. If the fish are just numbered 1 through 20, we have to give them new numbers for our database, making it more difficult to trace your fish to their analytical results and creating an additional possibility for errors.

2. Process and record fish of the same species sequentially. Recording mistakes are less likely when all fish from a species are processed together. Starting with the bigger fish species helps avoid missing an individual.

3. If using Bureau of Ecosystem Health supplied tags or other numbered tags, use tags in sequence so that fish are recorded with sequential Tag Numbers. This makes data entry and login at the lab and use of the data in the future easier and reduces keypunch errors.

4. Record length and weight as soon as possible after collection and before freezing. Other data are recorded in the field upon collection. An age determination of each fish is optional, but if done, it is recorded in the appropriate “Age” column.

5. For composite samples of small fish, record the number of fish in the composite in the Remarks column. Record the length and weight of each individual in a composite. All fish in a composite sample should be of the same species and members of a composite should be visually matched for size.

6. Please submit photocopies of topographic maps or good quality navigation charts indicating sampling locations. GPS coordinates can be entered in the Location column of the collection record form in addition to or instead for providing a map. These records are of immense help to us (and hopefully you) in providing documented location records which are not dependent on memory and/or the same collection crew. In addition, they may be helpful for contaminant source trackdown and remediation/control efforts of the Department.

7. When recording data on fish measurements, it will help to ensure correct data recording for the data recorder to call back the numbers to the person making the measurements.

E. Each fish is to be placed in its own individual plastic bag. For small fish to be analyzed as a composite, put all of the fish for one composite in the same bag but use a separate bag for each composite. It is important to individually bag the fish to avoid difficulties or cross contamination when processing the fish for chemical analysis. Be sure to include the fish’s tag number inside the bag, preferably attached to the fish with the tag number turned out so it can be read. Tie or otherwise secure the bag closed. **<u>The Bureau of Ecosystem Health will supply the bags.</u>** If necessary, food grade bags may be procured from a suitable vendor (e.g., grocery store). It is preferable to redundantly label each bag with a manila tag tied between the knot and the body of the bag. This tag should be labeled with the project name, collection location, tag number, collection date, and fish species. If scales are collected, the scale envelope should be labeled with the same information.

F. Groups of fish, by species, are to be placed in one large plastic bag per sampling location. **<u>The Bureau of Ecosystem Health will supply the larger bags</u>.** Tie or otherwise secure the bag closed. Label the site bag with a manila tag tied between the knot and the body of the bag. The tag should contain: project, collection location, collection date, species and **tag number ranges**. Having this information on the manila tag enables lab staff to know what is in the bag without opening it.

G. Do not eviscerate, fillet or otherwise dissect the fish unless specifically asked to. If evisceration or dissection is specified, the fish must be cut along the exact midline or on the right side so that the left side fillet can be removed intact at the laboratory. If filleting is specified, the procedure for taking a standard fillet (SOP PREPLAB 4) must be followed, including removing scales.

H. Special procedures for PFAS: Unlike legacy contaminants such as PCBs, which are rarely found in day to day life, PFAS are widely used and frequently encountered. Practices that avoid sample contamination are therefore necessary. While no standard practices have been established for fish, procedures for water quality sampling can provide guidance. The following practices should be used for collections when fish are to be analyzed for PFAS:

No materials containing Teflon.
No Post-it notes.
No ice packs; only water ice or dry ice.
Any gloves worn must be powder free nitrile.
No Gore-Tex or similar materials (Gore-Tex is a PFC with PFOA used in its manufacture).
No stain repellent or waterproof treated clothing; these are likely to contain PFCs.
Avoid plastic materials, other than HDPE, including clipboards and waterproof notebooks.
Wash hands after handling any food containers or packages as these may contain PFCs. Keep pre-wrapped food containers and wrappers isolated from fish handling.
Wear clothing washed at least six times since purchase.
Wear clothing washed without fabric softener.
Staff should avoid cosmetics, moisturizers, hand creams and similar products on the day of sampling as many of these products contain PFCs (Fujii et al. 2013). Sunscreen or insect repellent should not contain ingredients with “fluor” in their name. Apply any sunscreen or insect repellent well downwind from all materials. Hands must be washed after touching any of these products.

I. All fish must be kept at a temperature <45° F (<8° C) immediately following data processing. As soon as possible, freeze at -20° C ± 5° C. Due to occasional freezer failures, daily freezer temperature logs are required. The freezer should be locked or otherwise secured to maintain chain of custody.

J. In most cases, samples should be delivered to the Analytical Services Unit at the Hale Creek field station. Coordinate delivery with field station staff and send copies of the collection records, continuity of evidence forms and freezer temperature logs to the field station. For samples to be analyzed elsewhere, non-routine collections or other questions, contact Wayne Richter, Bureau of Ecosystem Health, NYSDEC, 625 Broadway, Albany, New York 12233-4756, 518-402-8974, or the project leader about sample transfer. Samples will then be directed to the analytical facility and personnel noted on specific project descriptions.

K. A recommended equipment list is at the end of this document.

page ______ of ______

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF FISH AND WILDLIFE
FISH COLLECTION RECORD

Project and Site Name ____ DEC Region ____________

Collections made by (include all crew) ____

Sampling Method: ☐Electrofishing ☐Gill netting ☐Trap netting ☐Trawling ☐Seining ☐Angling ☐Other ____________________

Preservation Method: ☐Freezing ☐Other ____________________ Notes (SWFDB survey number): ____________________

FOR LAB USE ONLY- LAB ENTRY NO.	COLLECTION OR TAG NO.	SPECIES	DATE TAKEN	LOCATION	AGE	SEX &/OR REPROD. CONDIT	LENGTH ( )	WEIGHT ( )	REMARKS

richter: revised 2011, 5/7/15, 10/4/16, 3/20/17; becker: 3/23/17, 4/26/19

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
CHAIN OF CUSTODY

I, ______________________________, of ____ collected the
(Print Name) (Print Business Address)

following on ____________________, 20____ from ____
(Date) (Water Body)

in the vicinity of ____
(Landmark, Village, Road, etc.)

Town of ____, in __________________________________ County.

Item(s) ____

____

Said sample(s) were in my possession and handled according to standard procedures provided to me prior to collection. The sample(s) were placed in the custody of a representative of the New York State Department of Environmental Conservation on ____________________________________, 20______.

____ ____________________________
Signature Date

I, __________________________________, received the above mentioned sample(s) on the date specified and assigned identification number(s) ____ to the sample(s). I have recorded pertinent data for the sample(s) on the attached collection records. The sample(s) remained in my custody until subsequently transferred, prepared or shipped at times and on dates as attested to below.

____ ____________________
Signature Date

SECOND RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
THIRD RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
FOURTH RECIPIENT (Print Name)	TIME & DATE	PURPOSE OF TRANSFER
SIGNATURE	UNIT	
RECEIVED IN LABORATORY BY (Print Name)	TIME & DATE	REMARKS
SIGNATURE	UNIT	
LOGGED IN BY (Print Name)	TIME & DATE	ACCESSION NUMBERS
SIGNATURE	UNIT	

richter: revised 21 April 2014; becker: 23 March 2017, 26 April, 2019

NOTICE OF WARRANTY

By signature to the chain of custody (reverse), the signatory warrants that the information provided is truthful and accurate to the best of his/her ability. The signatory affirms that he/she is willing to testify to those facts provided and the circumstances surrounding the same. Nothing in this warranty or chain of custody negates responsibility nor liability of the signatories for the truthfulness and accuracy of the statements provided.

HANDLING INSTRUCTIONS

On day of collection, collector(s) name(s), address(es), date, geographic location of capture (attach a copy of topographic map or navigation chart), species, number kept of each species, and description of capture vicinity (proper noun, if possible) along with name of Town and County must be indicated on reverse.

Retain organisms in manila tagged plastic bags to avoid mixing capture locations. Note appropriate information on each bag tag.

Keep samples as cool as possible. Put on ice if fish cannot be frozen within 12 hours. If fish are held more than 24 hours without freezing, they will not be retained or analyzed.

Initial recipient (either DEC or designated agent) of samples from collector(s) is responsible for obtaining and recording information on the collection record forms which will accompany the chain of custody. This person will seal the container using packing tape and writing his signature, the time and the date across the tape onto the container with indelible marker. Any time a seal is broken, for whatever purpose, the incident must be recorded on the Chain of Custody (reason, time, and date) in the purpose of transfer block. Container then is resealed using new tape and rewriting signature, with time and date.

EQUIPMENT LIST

Scale or balance of appropriate capacity for the fish to be collected.

Fish measuring board.

Plastic bags of an appropriate size for the fish to be collected and for site bags.

Individually numbered metal tags for fish.

Manila tags to label bags.

Small envelops, approximately 2” x 3.5”, if fish scales are to be collected.

Knife for removing scales.

Chain of custody and fish collection forms.

Clipboard.

Pens or markers.

Paper towels.

Dish soap and brush.

Bucket.

Cooler.

Ice.

Duct tape.

Appendix G – PFAS Analyte List

Group	Chemical Name	Abbreviation	CAS Number
Perfluoroalkyl sulfonates	Perfluorobutanesulfonic acid	PFBS	375-73-5
	Perfluorohexanesulfonic acid	PFHxS	355-46-4
	Perfluoroheptanesulfonic acid	PFHpS	375-92-8
	Perfluorooctanesulfonic 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

Appendix H - Laboratory Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

New York State Department of Environmental Conservation's Division of Environmental Remediation (DER) developed the following guidelines for laboratories analyzing environmental samples for PFAS under DER programs. If laboratories cannot adhere to the following guidelines, they should contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov prior to analysis of samples.

Isotope Dilution

Isotope dilution techniques should be utilized for the analysis of PFAS in all media.

Extraction

For water samples, the entire sample bottle should be extracted, and the sample bottle rinsed with appropriate solvent to remove any residual PFAS.

For samples with high particulates, the samples should be handled in one of the following ways:

1. Spike the entire sample bottle with isotope dilution analytes (IDAs) prior to any sample manipulation. The sample can be passed through the SPE and if it clogs, record the volume that passed through.
2. If the sample contains too much sediment to attempt passing it through the SPE cartridge, the sample should be spiked with isotope dilution analytes, centrifuged and decanted.
3. If higher reporting limits are acceptable for the project, the sample can be diluted by taking a representative aliquot of the sample. If isotope dilution analytes will be diluted out of the sample, they can be added after the dilution. The sample should be homogenized prior to taking an aliquot.

If alternate sample extraction procedures are used, please contact the DER remedial program chemist prior to employing. Any deviations in sample preparation procedures should be clearly noted in the case narrative.

Signal to Noise Ratio

For all target analyte ions used for quantification, signal to noise ratio should be 3:1 or greater.

Blanks

There should be no detections in the method blanks above the reporting limits.

Ion Transitions

The ion transitions listed below should be used for the following PFAS:

PFOA	413 > 369
PFOS	499 > 80
PFHxS	399 > 80
PFBS	299 > 80
6:2 FTS	427 > 407
8:2 FTS	527 > 507
N-EtFOSAA	584 > 419
N-MeFOSAA	570 > 419

Branched and Linear Isomers

Standards containing both branched and linear isomers should be used when standards are commercially available. Currently, quantitative standards are available for PFHxS, PFOS, NMeFOSAA, and NEtFOSAA. As more standards become available, they should be incorporated in to the method. All isomer peaks present in the standard should be integrated and the areas summed. Samples should be integrated in the same manner as the standards.

Since a quantitative standard does not exist for branched isomers of PFOA, the instrument should be calibrated using just the linear isomer and a technical (qualitative) PFOA standard should be used to identify the retention time of the branched PFOA isomers in the sample. The total response of PFOA branched and linear isomers should be integrated in the samples and quantitated using the calibration curve of the linear standard.

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated for each target analyte and the ratio compared to standards. Lab derived criteria should be used to determine if the ratios are acceptable.

Reporting

Detections below the reporting limit should be reported and qualified with a J qualifier.

The acid form of PFAS analytes should be reported. If the salt form of the PFAS was used as a stock standard, the measured mass should be corrected to report the acid form of the analyte.

Appendix I - Data Review Guidelines for Analysis of PFAS in Non-Potable Water and Solids

General

These guidelines are intended to be used for the validation of PFAS analytical results for projects within the Division of Environmental Remediation (DER) as well as aid in the preparation of a data usability summary report. Data reviewers should understand the methodology and techniques utilized in the analysis. Consultation with the end user of the data may be necessary to assist in determining data usability based on the data quality objectives in the Quality Assurance Project Plan. A familiarity with the laboratory's Standard Operating Procedure may also be needed to fully evaluate the data. If you have any questions, please contact DER's Quality Assurance Officer, Dana Barbarossa, at dana.barbarossa@dec.ny.gov.

Preservation and Holding Time

Samples should be preserved with ice to a temperature of less than 6°C upon arrival at the lab. The holding time is 14 days to extraction for aqueous and solid samples. The time from extraction to analysis for aqueous samples is 28 days and 40 days for solids.

Temperature greatly exceeds 6ºC upon arrival at the lab*	Use professional judgement to qualify detects and non-detects as estimated or rejected
Holding time exceeding 28 days to extraction	Use professional judgement to qualify detects and non-detects as estimated or rejected if holding time is grossly exceeded

*Samples that are delivered to the lab immediately after sampling may not meet the thermal preservation guidelines. Samples are considered acceptable if they arrive on ice or an attempt to chill the samples is observed.

Initial Calibration

The initial calibration should contain a minimum of five standards for linear fit and six standards for a quadratic fit. The relative standard deviation (RSD) for a quadratic fit calibration should be less than 20%. Linear fit calibration curves should have an R^2 value greater than 0.990.

The low-level calibration standard should be within 50% - 150% of the true value, and the mid-level calibration standard within 70% - 130% of the true value.

%RSD >20%	J flag detects and UJ non detects
R^2 >0.990	J flag detects and UJ non detects
Low-level calibration check <50% or >150%	J flag detects and UJ non detects
Mid-level calibration check <70% or >130%	J flag detects and UJ non detects

Initial Calibration Verification

An initial calibration verification (ICV) standard should be from a second source (if available). The ICV should be at the same concentration as the mid-level standard of the calibration curve.

ICV recovery <70% or >130%	J flag detects and non-detects

Continuing Calibration Verification

Continuing calibration verification (CCV) checks should be analyzed at a frequency of one per ten field samples. If CCV recovery is very low, where detection of the analyte could be in question, ensure a low level CCV was analyzed and use to determine data quality.

CCV recovery <70 or >130%	J flag results

Blanks

There should be no detections in the method blanks above the reporting limits. Equipment blanks, field blanks, rinse blanks etc. should be evaluated in the same manner as method blanks. Use the most contaminated blank to evaluate the sample results.

Blank Result	Sample Result	Qualification
Any detection	<Reporting limit	Qualify as ND at reporting limit
Any detection	>Reporting Limit and >10x the blank result	No qualification
>Reporting limit	>Reporting limit and <10x blank result	J+ biased high

Field Duplicates

A blind field duplicate should be collected at rate of one per twenty samples. The relative percent difference (RPD) should be less than 30% for analyte concentrations greater than two times the reporting limit. Use the higher result for final reporting.

RPD >30%	Apply J qualifier to parent sample

Lab Control Spike

Lab control spikes should be analyzed with each extraction batch or one for every twenty samples. In the absence of lab derived criteria, use 70% - 130% recovery criteria to evaluate the data.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects

Matrix Spike/Matrix Spike Duplicate

One matrix spike and matrix spike duplicate should be collected at a rate of one per twenty samples. Use professional judgement to reject results based on out of control MS/MSD recoveries.

Recovery <70% or >130% (lab derived criteria can also be used)	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only
RPD >30%	Apply J qualifier to detects and UJ qualifier to non detects of parent sample only

Extracted Internal Standards (Isotope Dilution Analytes)

Problematic analytes (e.g. PFBA, PFPeA, fluorotelomer sulfonates) can have wider recoveries without qualification. Qualify corresponding native compounds with a J flag if outside of the range.

Recovery <50% or >150%	Apply J qualifier
Recovery <25% or >150% for poor responding analytes	Apply J qualifier
Isotope Dilution Analyte (IDA) Recovery <10%	Reject results

Secondary Ion Transition Monitoring

Quantifier and qualifier ions should be monitored for all target analytes (PFBA and PFPeA are exceptions). The ratio of quantifier ion response to qualifier ion response should be calculated from the standards for each target analyte. Lab derived criteria should be used to determine if the ratios are acceptable. If the ratios fall outside of the laboratory criteria, qualify results as an estimated maximum concentration.

Signal to Noise Ratio

The signal to noise ratio for the quantifier ion should be at least 3:1. If the ratio is less than 3:1, the peak is discernable from the baseline noise and symmetrical, the result can be reported. If the peak appears to be baseline noise and/or the shape is irregular, qualify the result as tentatively identified.

Branched and Linear Isomers

Observed branched isomers in the sample that do not have a qualitative or quantitative standard should be noted and the analyte should be qualified as biased low in the final data review summary report. Note: The branched isomer peak should also be present in the secondary ion transition.

Reporting Limits

If project-specific reporting limits were not met, please indicate that in the report along with the reason (e.g. over dilution, dilution for non-target analytes, high sediment in aqueous samples).

Peak Integrations

Target analyte peaks should be integrated properly and consistently when compared to standards. Ensure branched isomer peaks are included for PFAS where standards are available. Inconsistencies should be brought to the attention of the laboratory or identified in the data review summary report.

ATTACHMENT 3

Roux’s Standard Operating Procedures

Date: May 5, 2000

1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for decontamination of all field equipment potentially exposed to contamination during drilling, and soil and water sampling. The objective of decontamination is to ensure that all drilling, and soil-sampling and water-sampling equipment is decontaminated (free of potential contaminants): 1) prior to being brought onsite to avoid the introduction of potential contaminants to the site; 2) between drilling and sampling events/activities onsite to eliminate the potential for cross-contamination between boreholes and/or wells; and 3) prior to the removal of equipment from the site to prevent the transportation of potentially contaminated equipment offsite.

In considering decontamination procedures, state and federal regulatory agency requirements must be considered because of potential variability between state and federal requirements and because of variability in the requirements of individual states. Decontamination procedures must be in compliance with state and/or federal protocols in order that regulatory agency(ies) scrutiny of the procedures and data collected do not result in non-acceptance (invalidation) of the work undertaken and data collected.

2.0 PROCEDURE FOR DRILLING EQUIPMENT

The following is a minimum decontamination procedure for drilling equipment. Drilling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

2.1 The rig and all associated equipment should be properly decontaminated by the contractor before arriving at the test site.

2.2 The augers, drilling casings, rods, samplers, tools, rig, and any piece of equipment that can come in contact (directly or indirectly) with the soil, will be steam cleaned onsite prior to set up for drilling to ensure proper decontamination.

2.3 The same steam cleaning procedures will be followed between boreholes (at a fixed on-site location[s], if appropriate) and before leaving the site at the end of the study.

2.4 All on-site steam cleaning (decontamination) activities will be monitored and documented by a member(s) of the staff of Roux Associates, Inc.

2.5 If drilling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat drilling equipment, then special decontamination procedures may have to be utilized before steam cleaning (e.g., hexane scrub and wash).

2.6 Containment of decontamination fluids may be necessary (e.g., rinseate from steam cleaning) or will be required (e.g., hexane), and disposal must be in accordance with state and/or federal procedures.

3.0 PROCEDURE FOR SOIL-SAMPLING EQUIPMENT

The following is a minimum decontamination procedure for soil-sampling equipment (e.g., split spoons, stainless-steel spatulas). Soil-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

3.1 Wear disposable gloves while cleaning equipment to avoid cross-contamination and change gloves as needed.

3.2 Steam clean the sampler or rinse with potable water. If soil-sampling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat sampling equipment, then special decontamination procedures may have to be utilized before steam cleaning and washing in detergent solution (e.g., hexane scrub and wash).

3.3 Prepare a non-phosphate, laboratory-grade detergent solution and distilled or potable water in a clean bucket.

3.4 Disassemble the sampler, as necessary and immerse all parts and other sampling equipment in the solution.

3.5 Scrub all equipment in the bucket with a brush to remove any adhering particles.

3.6 Rinse all equipment with copious amounts of potable water followed by distilled or deionized water.

3.7 Place clean equipment on a clean plastic sheet (e.g., polyethylene)

3.8 Reassemble the cleaned sampler, as necessary.

3.9 Transfer the sampler to the driller (or helper) making sure that this individual is also wearing clean gloves or wrap the equipment with a suitable material (e.g., plastic bag, aluminum foil.

As part of the decontamination procedure for soil-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

4.0 PROCEDURE FOR WATER-SAMPLING EQUIPMENT

The following is a decontamination procedure for water-sampling equipment (e.g., bailers, pumps). Water-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

4.1 Decontamination procedures for bailers follow:

a. Wear disposable gloves while cleaning bailer to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a bucket.

c. Disassemble bailer (if applicable) and discard cord in an appropriate manner and scrub each part of the bailer with a brush and solution.

d. Rinse with potable water and reassemble bailer.

e. Rinse with copious amounts of distilled or deionized water.

f. Air dry.

g. Wrap equipment with a suitable material (e.g., clean plastic bag, aluminum foil).

h. Rinse bailer at least three times with distilled or deionized water before use.

4.2 Decontamination procedures for pumps follow:

a. Wear disposable gloves while cleaning pump to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a clean bucket, clean garbage can, or clean 55-gallon drum.

c. Flush the pump and discharge hose (if not disposable) with the detergent solution and discard disposable tubing and/or cord in an appropriate manner.

d. Flush the pump and discharge hose (if not disposable) with potable water.

e. Place the pump on clear plastic sheeting.

f. Wipe any pump-related equipment (e.g., electrical lines, cables, discharge hose) that entered the well with a clean cloth and detergent solution, and rinse or wipe with a clean cloth and potable water.

g. Air dry.

h. Wrap equipment with a suitable material (e.g., clean plastic bag).

As part of the decontamination procedure for water-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

STANDARD OPERATING PROCEDURE 5.1
FOR COLLECTION OF SOIL SAMPLES
FOR LABORATORY ANALYSIS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis. This SOP is applicable to soil samples collected from split-spoon samplers during drilling, hand auger samples, grab samples from stockpiled soils, surface samples, test pit samples, etc.

2.0 CONSIDERATIONS

Soil samples may be collected in either a random or biased manner. Random samples can be based on a grid system or statistical methodology. Biased samples can be collected in areas of visible impact or suspected source areas. Soil samples can be collected at the surface, shallow subsurface, or at depth. When samples are collected at depth the water content should be noted, since generally “soil sampling” is restricted to the unsaturated zone. Equipment selection will be determined by the depth of the sample to be collected. A thorough description of the sampling locations and proposed methods of sample collection should be included in the work plan.

Commonly, surface sampling refers to the collection of samples at a 0 to 6-inch depth interval. Certain regulatory agencies may define the depth interval of a surface sample differently, and this must be defined in the work plan. Collection of surface soil samples is most efficiently accomplished with the use of a stainless-steel trowel or scoop. For samples at greater depths a decontaminated bucket auger or power auger may be needed to advance the hole to the point of sample collection. Another clean bucket auger should then be used to collect the sample. To collect samples at depths of greater than approximately six feet the use of a drill rig and split spoon samples will usually be necessary. In some situations, sample locations are accessed with the use of a backhoe.

3.0 MATERIALS/EQUIPMENT

a. A work plan which outlines soil sampling requirements.

b. Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.

c. Decontamination supplies (including: non-phosphate, laboratory grade detergent, buckets, brushes, potable water, distilled water, regulatory-required reagents, aluminum foil, plastic sheeting, etc.).

d. Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

e. Stainless steel spoons or spatulas.

f. Disposable sampling gloves.

g. Laboratory-supplied sample containers with labels.

h. Cooler with blue or wet ice.

i. Plastic sheeting.

j. Black pen and indelible marker.

k. Zip-lock bags and packing material.

l. Tape measure.

m. Paper towels or clean rags.

n. Masking and packing tape.

o. Overnight (express) mail forms.

4.0 DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to the decontamination SOP. Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and plastic sheeting will be changed after each use and discarded in an appropriate manner.

5.0 PROCEDURE

5.1 Prior to collecting soil samples, ensure that all sampling equipment has been thoroughly cleaned according to the decontamination SOP. If samples are to be collected at depth, then the boring must be advanced with thoroughly cleaned equipment to the desired sampling horizon and a different thoroughly cleaned sampler must be used to collect the sample.

5.2 Using disposable gloves and a pre-cleaned, stainless steel spatula or spoon, extract the soil sample from the sampler, measure the recovery, and separate the wash from the true sample. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.

5.3 Place the sample in a laboratory-supplied, pre-cleaned sample container. This should be done as quickly as possible and this is especially important when sampling for volatile organic compounds (VOCs). Samples to be analyzed for VOCs must be collected prior to other constituents.

5.4 The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials.

5.5 Using the remaining portion of soil from the sampler, log the sample in detail and record sediment characteristics (color, odor, moisture, texture, density, consistency, organic content, layering, grain size, etc.).

5.6 If soil samples are to be composited in the field, then equal portions from selected locations will be placed on a clean plastic sheet and homogenized. Alternately, several samples may be submitted to the laboratory for compositing by weight. The method used is dependent upon regulatory requirements. Specific compositing procedures shall be approved by the appropriate regulatory agency and described in the work plan. Samples to be analyzed for VOCs will not be composited unless required by a regulatory agency.

5.7 After the sample has been collected, labeled, and logged in detail, it is placed in a zip-lock bag and stored in a cooler at 4°C.

5.8 A chain-of-custody form is completed for all samples collected. One copy is retained and two are sent with the samples in a zip-lock bag to the laboratory. A custody seal is placed on the cooler prior to shipment.

5.9 Samples collected from Monday to Friday are to be delivered to the laboratory within 24 hours of collection. If Saturday delivery is unavailable, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if any analytes require a shorter delivery time.

5.10 The field notebook and appropriate forms should include, but not be limited to the following: client name, site location, sample location, sample depth, sample identification, date and time collected, sampler’s name, method of sample collection, number and type of containers, geologic description of material, description of decontamination procedures, etc. A site map should be prepared with exact measurements to each sample location in case follow-up sampling is necessary.

5.11 All reusable sampling equipment must be thoroughly cleaned in accordance with the decontamination SOP. Following the final decontamination (after all samples are collected) the sampling equipment is wrapped in aluminum foil. Discard any gloves, foil, plastic, etc. in an appropriate manner that is consistent with site conditions.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for sample handling which will allow consistent and accurate results. Valid chemistry data are integral to investigations that characterize media-quality conditions. Thus, this SOP is designed to ensure that once samples are collected, they are preserved, packed and delivered in a manner which will maintain sample integrity to as great an extent as possible. The procedures outlined are applicable to most sampling events and any required modifications must be clearly described in the work plan.

2.0 CONSIDERATIONS

Sample containers, sampling equipment decontamination, quality assurance/quality control (QA/QC), sample preservation, and sample handling are all components of this SOP.

2.1 Sample Containers

Prior to collection of a sample, considerations must be given to the type of container that will be used to store and transport the sample. The type and number of containers selected is usually based on factors such as sample matrix, potential contaminants to be encountered, analytical methods requested, and the laboratory's internal quality assurance requirements. In most cases, the overriding considerations will be the analytical methodology, or the state or federal regulatory requirements because these regulations generally encompass the other factors. The sample container selected is usually based on some combination of the following criteria:

a. Reactivity of Container Material with Sample

Choosing the proper composition of sample containers will help to ensure that the chemical and physical integrity of the sample is maintained. For sampling potentially hazardous material, glass is the recommended container type because it is chemically inert to most substances. Plastic containers are not recommended for most hazardous wastes because the potential exists for contaminants to adsorb to the surface of the plastic or for the plasticizer to leach into the sample.

In some instances, however, the sample characteristics or analytes of interest may dictate that plastic containers be used instead of glass. Because some metals species will adhere to the sides of the glass containers in an aqueous matrix, plastic bottles (e.g., nalgene) must be used for samples collected for metals analysis. A separate, plastic container should accompany glass containers if metals analysis is to be performed along with other analyses. Likewise, other sample characteristics may dictate that glass cannot be used. For example, in the case of a strong alkali waste or hydrofluoric solution, plastic containers may be more suitable because glass containers may be etched by these compounds and create adsorptive sites on the container's surface.

b. Volume of the Container

The volume of sample to be collected will be dictated by the analysis being performed and the sample matrix. The laboratory must supply bottles of sufficient volume to perform the required analysis. In most cases, the methodology dictates the volume of sample material required to complete the analysis. However, individual laboratories may provide larger volume containers for various analytes to ensure sufficient quantities for duplicates or other QC checks.

To facilitate transfer of the sample from the sampler into the container and to minimize spillage and sample disturbance, wide-mouth containers are recommended. Aqueous volatile organic samples must be placed into 40-milliliter (ml) glass vials with polytetrafluoroethylene (PTFE) (e.g., TeflonTM) septums. Non-aqueous volatile organic samples should be collected in the same type of vials or in 4-ounce (oz) wide-mouth jars provided by the laboratory. These jars should have PTFE-lined screw caps.

c. Color of Container

Whenever possible, amber glass containers should be used to prevent photodegradation of the sample, except when samples are being collected for metals analysis. If amber containers are not available, then containers holding samples should be protected from light (i.e., place in cooler with ice immediately after filling).

d. Container Closures

Container closures must screw on and off the containers and form a leak-proof seal. Container caps must not be removed until the container is ready to be filled with the sample, and the container cap must be replaced (securely) immediately after filling it. Closures should be constructed of a material which is inert with respect to the sampled material, such as PTFE (e.g., TeflonTM). Alternately, the closure may be separated from the sample by a closure liner that is inert to the sample material such as PTFE sheeting. If soil or sediment samples are being collected, the threads of the container must be wiped clean with a dedicated paper towel or cloth, so the cap can be threaded properly.

e. Decontamination of Sample Containers

Sample containers must be laboratory cleaned by the laboratory performing the analysis. The cleaning procedure is dictated by the specific analysis to be performed on the sample. Sample containers must be carefully examined to ensure that all containers appear clean. Do not mistake the preservative as unwanted residue. The bottles should not be field cleaned. If there is any question regarding the integrity of the bottle, then the laboratory must be contacted immediately and the bottle(s) replaced.

f. Sample Bottle Storage and Transport

No matter where the sample bottles are, whether at the laboratory waiting to be packed for shipment or in the field waiting to be filled with sample, care must be taken to avoid contamination. Sample shuttles or coolers, and sample bottles must be stored and transported in clean environments. Sample bottles and clean sampling equipment must never be stored near solvents, gasoline, or other equipment that is a potential source of cross-contamination. When under chain of custody, sample bottles must be secured in locked vehicles, and custody sealed in shuttles or in the presence of authorized personnel. Information which documents that proper storage and transport procedures have been followed must be included in the field notebook and on appropriate field forms.

2.2 Decontamination of Sampling Equipment

Proper decontamination of all re-usable sampling equipment is critical for all sampling episodes. The SOP for Decontamination of Field Equipment and SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for decontamination of various types of equipment.

2.3 Quality Assurance/Quality Control Samples

QA/QC samples are intended to provide control over the proper collection and tracking of environmental measurements, and subsequent review, interpretation and validation of generated analytical data. The SOPs for Collection of Quality Control Samples, for Evaluation and Validation of Data, and for Field Record Keeping and Quality Assurance/Quality Control must be referred to for detailed guidance regarding these respective procedures. SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for QA/QC procedures.

2.4 Sample Preservation Requirements

Certain analytical methodologies for specific analytes require chemical additives in order to stabilize and maintain sample integrity. Generally, this is accomplished under the following two scenarios:

a. Sample bottles are preserved at the laboratory prior to shipment into the field.

b. Preservatives are added in the field immediately after the samples are collected.

Many laboratories provide pre-preserved bottles as a matter of convenience and to help ensure that samples will be preserved immediately upon collection. A problem associated with this method arises if not enough sample could be collected, resulting in too much preservative in the sample. More commonly encountered problems with this method include the possibility of insufficient preservative provided to achieve the desired pH level or the need for additional preservation due to chemical reactions caused by the addition of sample liquids to pre-preserved bottles. The use of pre-preserved bottles is acceptable; however, field sampling teams must always be prepared to add additional preservatives to samples if the aforementioned situations occur. Furthermore, care must be exercised not to overfill sample bottles containing preservatives to prevent the sample and preservative from spilling and therefore diluting the preservative (i.e., not having enough preservative for the volume of sample).

When samples are preserved after collection, special care must be taken. The transportation and handling of concentrated acids in the field requires additional preparation and adherence to appropriate preservation procedures. All preservation acids used in the field should be trace-metal or higher-grade.

2.5 Sample Handling

After the proper sample bottles have been received under chain-of-custody, properly decontaminated equipment has been used to collect the sample, and appropriate preservatives have been added to maintain sample integrity, the final step for the field personnel is checking the sample bottles prior to proper packing and delivery of the samples to the laboratory.

All samples should be organized and the labels checked for accuracy. The caps should be checked for tightness and any 40-ml volatile organic compound (VOC) bottles must be checked for bubbles. Each sample bottle must be placed in an individual Ziploc® bag to protect the label, and placed on ice. The bottles must be carefully packed to prevent breakage during transport. When several bottles have been collected for an individual sample, they should not be placed adjacent to each other in the cooler to prevent possible breakage of all bottles for a given sample. If there are any samples which are known or suspected to be highly contaminated, these should be placed in an individual cooler under separate chain-of-custody to prevent possible cross contamination. Sufficient ice (wet or blue packs) should be placed in the cooler to maintain the temperature at 4 degrees Celsius (°C) until delivery at the laboratory. Consult the work plan to determine if a particular ice is specified as the preservation for transportation (e.g., the United States Environmental Protection Agency does not like the use of blue packs because they claim that the samples will not hold at 4°C). If additional coolers are required, then they should be purchased. The chain-of-custody form should be properly completed, placed in a "zip-lock" bag, and placed in the cooler. One copy must be maintained for the project files. The cooler should be sealed with packing tape and a custody seal. The custody seal number should be noted in the field book. Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time. If overnight mail is utilized, then the shipping bill must be maintained for the files and the laboratory must be called the following day to confirm receipt.

3.0 EQUIPMENT AND MATERIALS

3.1 General equipment and materials may include, but not necessarily be limited to, the following:

a. Sample bottles of proper size and type with labels.

b. Cooler with ice (wet or blue pack).

c. Field notebook, appropriate field form(s), chain-of-custody form(s), custody seals.

d. Black pen and indelible marker.

e. Packing tape, "bubble wrap," and "zip-lock" bags.

f. Overnight (express) mail forms and laboratory address.

g. Health and safety plan (HASP).

h. Work plan/scope of work.

i. Pertinent SOPs for specified tasks and their respective equipment and materials.

3.2 Preservatives for specific samples/analytes as specified by the laboratory. Preservatives must be stored in secure, spillproof glass containers with their content, concentration, and date of preparation and expiration clearly labeled.

3.3 Miscellaneous equipment and materials including, but not necessarily limited to, the following:

a. Graduated pipettes.

b. Pipette bulbs.

c. Litmus paper.

d. Glass stirring rods.

e. Protective goggles.

f. Disposable gloves.

g. Lab apron.

h. First aid kit.

i. Portable eye wash station.

j. Water supply for immediate flushing of spillage, if appropriate.

k. Shovel and container for immediate containerization of spillage-impacted soils, if appropriate.

4.0 PROCEDURE

4.1 Examine all bottles and verify that they are clean and of the proper type, number, and volume for the sampling to be conducted.

4.2 Label bottles carefully and clearly with project name and number, site location, sample identification, date, time, and the sampler's initials using an indelible marker.

4.3 Collect samples in the proper manner (refer to specific sampling SOPs).

4.4 Conduct preservation activities as required after each sample has been collected. Field preservation must be done immediately and must not be done later than 30 minutes after sample collection.

4.5 Conduct QC sampling, as required.

4.6 Seal each container carefully and place in an individual "zip lock" bag.

4.7 Organize and carefully pack all samples in the cooler immediately after collection (e.g., bubble wrap). Insulate samples so that breakage will not occur.

4.8 Complete and place the chain-of-custody form in the cooler after all samples have been collected. Maintain one copy for the project file. If the cooler is to be transferred several times prior to shipment or delivery to the laboratory, it may be easier to tape the chain-of-custody to the exterior of the sealed cooler. When exceptionally hazardous samples are known or suspected to be present, this should be identified on the chain-of-custody as a courtesy to the laboratory personnel.

4.9 Add additional ice as necessary to ensure that it will last until receipt by the laboratory.

4.10 Seal the cooler with packing tape and a custody seal. Record the number of the custody seal in the field notebook and on the field form. If there are any exceptionally hazardous samples, then shipping regulations should be examined to ensure the sample containers and coolers are in compliance and properly labeled.

4.11 Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

4.12 Maintain the shipping bill for the project files if overnight mail is utilized and call the laboratory the following day to confirm receipt.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for the sampling of ground-water monitoring wells for dissolved constituents. As part of the SOP for the sampling of ground-water monitoring wells, sample collection equipment and devices must be considered, and equipment decontamination and pre-sampling procedures (e.g., measuring water levels, sounding wells, and purging wells) must be implemented. Sampling objectives must be firmly established in the work plan before considering the above.

Valid water-chemistry data are integral to a hydrogeologic investigation that characterizes ground-water quality conditions. Water-quality data are used to evaluate both current and historic aquifer chemistry conditions, as well as to estimate future conditions (e.g., trends, migration pathways). Water-quality data can be used to construct ground-water quality maps to illustrate chemical conditions within the flow system, to generate water-quality plots to depict conditions with time and trends, and to perform statistical analyses to quantify data variability, trends, and cleanup levels.

2.0 EQUIPMENT AND MATERIALS

2.1 In order to sample ground water from monitoring wells, specific equipment and materials are required. The equipment and materials list may include, but not necessarily be limited to, the following:

a. Bailers (Teflon™ or stainless steel).

b. Pumps (centrifugal, peristaltic, bladder, electric submersible, bilge, hand-operated diaphragm, etc.).

c. Gas-displacement device(s).

d. Air-lift device(s).

e. Teflon™ tape, electrical tape.

f. Appropriate discharge hose.

g. Appropriate discharge tubing (e.g., polypropylene, teflon, etc.) if using a peristaltic pump.

h. Appropriate compressed gas if using bladder-type or gas-displacement device.

i. Portable generator and gasoline or alternate power supply if using an electric submersible pump.

j. Non-absorbent cord (e.g., polypropylene, etc.).

k. Plastic sheeting.

l. Tape measure (stainless steel, steel, fiberglass) with 0.01-foot measurement increments and chalk (blue carpenter's).

m. Electronic water-level indicators (e.g., m-scope, etc.) or electric water-level/product level indicators.

n. Non-phosphate, laboratory-grade detergent.

o. Distilled/Deionized water.

p. Potable water.

q. Paper towels, clean rags.

r. Roux Associates' field forms (e.g., daily log, well inspection checklist, sampling, etc.) and field notebook.

s. Well location and site map.

t. Well keys.

u. Stop watch, digital watch with second increments, or watch with a second hand.

v. Water Well Handbook.

w. Calculator.

x. Black pen and water-proof marker.

y. Tools (e.g., pipe wrenches, screwdrivers, hammer, pliers, flashlight, pen knife, etc.).

z. Appropriate health and safety equipment, as specified in the site health and safety plan (HASP).

aa. pH meter(s) and buffers.

bb. Conductivity meter(s) and standards.

cc. Thermometer(s).

dd. Extra batteries (meters, thermometers, flashlight).

ee. Filtration apparatus, filters, pre-filters.

ff. Plasticware (e.g., premeasured buckets, beakers, flasks, funnels).

gg. Disposable gloves.

hh. Water jugs.

ii. Laboratory-supplied sample containers with labels.

jj. Cooler(s).

kk. Ice (wet, blue packs).

ll. Masking, duct, and packing tape.

mm. Chain-of-custody form(s) and custody seal(s).

nn. Site sampling and analysis plan (SAP).

oo. Site health and safety plan (HASP).

pp. Packing material (e.g., bubble wrap)

qq. "Zip-lock" plastic bags.

rr. Overnight (express) mail forms.

3.0 DECONTAMINATION

3.1 Make sure all equipment is decontaminated and cleaned before use (refer to the SOP for Decontamination of Field Equipment for detailed decontamination methods, summaries for bailers and pumps are provided below). Use new, clean materials when decontamination is not appropriate (e.g., non-absorbent cord, disposable gloves). Document, and initial and date the decontamination procedures on the appropriate field form and in the field notebook.

a. Decontaminate a bailer by: 1) wearing disposable gloves, 2) disassembling (if appropriate) and scrubbing in a non-phosphate, laboratory-grade detergent and distilled/deionized water solution, and 3) rinsing first with potable water and then distilled/deionized water.

b. Decontaminate a pump by: 1) wearing disposable gloves, 2) flushing the pump and discharge hose (if not disposable) first with a non-phosphate, laboratory-grade detergent and potable water solution in an appropriate container (clean bucket, garbage can, or 55-gallon drum) and then with distilled/deionized water or potable water, and 3) wiping pump-related equipment (e.g., electrical lines, cables, discharge hose) first with a clean cloth and detergent solution and then rinsing or wiping with a clean cloth and distilled/deionized water or potable water.

3.2 Note that the decontamination procedures for bailers and pumps are the minimum that must be performed. Check the work plan to determine if chemicals specified by individual state regulatory agencies must also be used for decontamination procedures (e.g., hexane, nitric acid, acetone, isopropanol, etc.).

4.0 CALIBRATION OF FIELD ANALYSIS EQUIPMENT

Calibrate field analysis equipment before use (e.g., thermometers, pH and conductivity meters, etc.). Refer to the specific SOP for field analysis for each respective piece of equipment. Document, and initial and date the calibration procedures on the appropriate field form, in the field notebook, and in the calibration log book.

5.0 PROCEDURE

5.1 Document, and initial and date well identification, pre-sampling information, and problems encountered on the appropriate field form and in the field notebook as needed.

5.2 Inspect the protective casing of the well and the well casing, and note any items of concern such as a missing lock, or bent or damaged casing(s).

5.3 Place plastic sheeting around the well to protect sampling equipment from potential cross contamination.

5.4 Remove the well cap or plug and, if necessary, clean the top of the well off with a clean rag. Place the cap or plug on the plastic sheeting. If the well is not vented, allow several minutes for the water level in the well to equilibrate. If fumes or gases are present, then diagnose these with the proper safety equipment. Never inhale the vapors.

5.5 Measure the depth to water (DTW) from the measuring point (MP) on the well using a steel tape and chalk or an electronic sounding device (m-scope). Refer to the specific SOPs for details regarding the use of a steel tape or a m-scope for measuring water levels. Calculate the water-level elevation. Document, and initial and date the information on the appropriate field form and in the field notebook.

5.6 Measuring the total depth of the well from the MP with a weighted steel tape. Calculate and record the volume of standing water in the well casing on the appropriate field form and in the field notebook.

5.7 Decontaminate the equipment used to measure the water level and sound the well with a non-phosphate, laboratory-grade detergent solution followed by a distilled/deionized water rinse.

5.8 Purge the well prior to sampling (refer to the SOP for Purging a Well). The well should be pumped or bailed to remove the volume of water specified in the work plan. Usually three to five casing volumes are removed if the recharge rate is adequate to accomplish this within a reasonable amount of time.

If the formation cannot produce enough water to sustain purging, then one of two options must be followed. These include: 1) pumping or bailing the well dry, or 2) pumping or bailing the well to "near-dry" conditions (i.e., leaving some water in the well). The option employed must be specified in the work plan and be in accordance with regulatory requirements.

If the well is purged dry, then all the standing water has been removed and upon recovery the well is ready for sampling. However, depending on the rate of recovery and the time needed to complete the sampling round, one of the following procedures may have to be implemented: 1) the well may have to be sampled over a period of more than one day; 2) the well may not yield enough water to collect a complete suite of samples and only select (most important) samples will be collected; or 3) the well may not recover which will preclude sampling. Regardless of the option that must be followed, the sampling procedure must be fully documented. When preparing to conduct a sampling round, review drilling, development, and previous sampling information (if available) to identify low-yielding wells in order to purge them first, and potentially allow time for the well to recover for sampling.

5.9 Record the physical appearance of the water (i.e. color, turbidity, odor, etc.) on the appropriate field form and in the field notebook, as it is purged. Note any changes that occur during purging.

5.10 If a bailer is used to collect the sample, then:

a. Flush the decontaminated bailer three times with distilled/deionized water.

b. Tie the non-absorbent cord (polypropylene) to the bailer with a secure knot and then tie the free end of the bailer cord to the protective casing or, if possible, some nearby structure to prevent losing the bailer and cord down the well.

c. Lower the bailer slowly down the well and into the water column to minimize disturbance of the water surface. If a bottom-filling bailer is used, then do not submerge the top of the bailer; however, if a top-filling bailer is used, then submerge the bailer several feet below the water surface.

d. Remove and properly discard one bailer volume from the well to rinse the bailer with well water before sampling. Again, lower the bailer slowly down the well to the appropriate depth depending on the bailer type (as discussed above in 5.11 c). When removing the bailer from the well, do not allow the bailer cord to rest on the ground but coil it on the protective plastic sheeting placed around the well. Certain regulatory agencies require that the first bailer volume collected be utilized for the samples.

5.11 If a pump is used to collect the sample, then use the same pump used to purge the well and, if need be, reduce the discharge rate to facilitate filling sample containers and to avoid problems that can occur while filling sample containers (as listed in Number 5.14, below). Alternately, the purge pump may be removed and a thoroughly decontaminated bailer can be used to collect the sample.

5.12 Remove each appropriate container's cap only when ready to fill each with the water sample, and then replace and secure the cap immediately.

5.13 Fill each appropriate, pre-labeled sample container carefully and cautiously to prevent: 1) agitating or creating turbulence; 2) breaking the container; 3) entry of, or contact with, any other medium; and 4) spilling/splashing the sample and exposing the sampling team to contaminated water. Immediately place the filled sample container in an ice-filled (wet ice or blue pack) cooler for storage. If wet ice is used it is recommended that it be repackaged in zip-lock bags to help keep the cooler dry and the sample labels secure. Check the work plan as to whether wet ice or blue packs are specified for cooling the samples because certain regulatory agencies may specify the use of one and not the other.

5.14 "Top-off" containers for volatile organic compounds (VOCs) and tightly seal with Teflon™-lined septums held in place by open-top screw caps to prevent volatilization. Ensure that there are no bubbles by turning the container upside down and tapping it gently.

5.15 Filter water samples (Procedure 4.6) collected for dissolved metals analysis prior to preservation to remove the suspended sediment from the sample. If water samples are to be collected for total metals analysis, then collect a second set of samples without field filtering.

In the event that the regulatory agency(ies) want unfiltered samples for metals analysis, a second set of filtered samples should also be collected. Because unfiltered samples are indications of total metals (dissolved and suspended) they are not representative of aquifer conditions because ground water does not transport sediment (except in some rare cases). Thus, the results for dissolved metals in ground water should be based on filtered samples even if both filtered and unfiltered sets are presented in a report.

5.16 Add any necessary preservative(s) to the appropriate container(s) prior to, or after (preferred), the collection of the sample, unless the appropriate preservative(s) have already been added by the laboratory before shipment.

5.17 Collect quality control (QC) samples as required in the work plan to monitor sampling and laboratory performance. Refer to the SOP for Collection of Quality Control Samples.

5.18 Conduct field analyses after sample collection is complete by measuring and recording the temperature, conductivity, pH, etc. (as called for in the work plan). Note and record the "final" physical appearance of the water (after purging and sampling) on an appropriate field form and in the field notebook.

5.19 Wipe the well cap with a clean rag, replace the well cap and protective cover (if present). Lock the protective cover.

5.20 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," placed in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory.

5.21 Decontaminate bailers, hoses, and pumps as discussed in the decontamination SOP. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard cords, rags, gloves, etc. in a manner consistent with site conditions.

5.22 Complete all necessary field forms, field notebook entries, and the chain-of-custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

5.23 Samples collected from Monday through Friday will be delivered within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Consult the work plan to determine if any of the analytes require a shorter delivery time.

END OF PROCUDURE

STANDARD OPERATING PROCEDURE 5.4
FOR SCREENING SOIL SAMPLES FOR VOLATILE ORGANIC VAPORS USING A PORTABLE PHOTOIONIZATION DETECTOR

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for screening soil samples for volatile organic vapors using a portable photoionization detector (PID). This SOP is applicable to soil samples collected from split-spoon samplers during drilling, hand auger samples, and grab samples from stockpiled soils.

2.0 CONSIDERATIONS

The primary objective of photoionization screening of soil samples is to obtain a qualitative understanding of the distribution of volatile organic compounds (VOCs) in soil. The proper design of an organic vapor screening program requires an understanding of site hydrogeology, potential source areas, and potential constituents of concern. Sample locations and frequency must be fully defined in the work plan. The work plan should outline the type of lamp to be utilized in the PID based on the ionization potentials and response factors of the constituents of concern. The work plan must also clearly describe the heating or equilibration procedures to be employed if they differ from those described in this SOP. Regardless of the specific equilibration procedure employed, it is imperative that each sample be treated identically to allow the photoionization results from different locations to be compared. Observations such as water, clay, and organic content should be noted to facilitate interpretation of the data. Every effort should be made to collect a representative portion of soil from the sampling device.

3.0 MATERIALS/EQUIPMENT

a. A work plan which outlines photoionization screening requirements.

b. Decontamination supplies (including: non-phosphate, laboratory grade detergent, buckets, brushes, potable water, distilled water, regulatory-required reagents [e.g., acetone, nitric acid, hexane, etc.], aluminum foil, plastic sheeting, etc.).

c. Field notebook, field form(s), maps, chain-of-custody forms.

d. Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

e. Stainless steel spoons or spatulas.

f. Disposable plastic spoons.

g. Plastic sheeting.

h. Aluminum foil.

i. Mason jars or driller's jars.

j. Water bath (hot plate, extension cord, water tray, thermometer).

k. Photoionization detector with charging unit.

l. Calibration gases with regulator.

m. Indelible marker.

n. Masking tape.

o. Disposable sampling gloves.

4.0 DECONTAMINATION

Where possible, thoroughly pre-cleaned and wrapped sampling equipment must be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and sample jars will be changed after each use and discarded in an appropriate manner. If only photoionization results are to be obtained, then split-spoon samples and hand augers may be cleaned with a soap and water wash and potable water rinse or steam cleaning, and a final distilled water rinse. However, if samples are to be collected concurrently for laboratory analytical results, then all reusable sampling equipment must be thoroughly decontaminated according to the SOP for decontamination of field equipment.

5.0 CALIBRATION

The PID must be calibrated according to the manufacturer's specifications at a minimum frequency of once per day prior to collecting photoionization readings. In addition, periodic checks (e.g., every 2 hours or every ten samples) with the standard gas will be conducted to confirm that the calibration has not drifted. The time, date, and calibration procedure must be clearly documented in the field notebook and the calibration log. If at any time the photoionization results appear erratic or inconsistent with field observations, then the unit must be recalibrated. If calibration is difficult to achieve, then the unit's lamp should be checked for dirt or moisture and cleaned, as necessary. During humid or wet conditions, the unit should be calibrated on a more frequent basis as determined by field personnel.

6.0 PROCEDURE

6.1 Extract the soil sample from the sampler, quickly measure the recovery, and separate the wash from the true sample by using a dedicated, stainless steel spatula. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.

6.2 Place the sample in a pre-cleaned glass jar (as quickly as possible to avoid loss of VOCs) filling the jar half full. Place an aluminum foil seal between the glass and metal cap and screw tight.

6.3 Label jars with the boring number, depth of sample, date of collection and blow counts. In addition, the field personnel will ensure the following: samples are taken at appropriate depths; unrepresentative portions of the sample are discarded properly; that the sampler is decontaminated properly between use; and the driller uses proper methods during sample collection and does not use oil or grease on tools entering the borehole.

6.4 Log the sample in detail and record sediment characteristics (color, odor, moisture, texture, density, consistency, organic content, and layering).

6.5 After the sample has been collected, heat the sample under controlled conditions in a water bath for a 2 minute period.

6.6 Ensure that the PID has been calibrated and that the calibration information is documented in the field book. Pierce the aluminum foil seal with the probe from the PID and measure the relative concentration of VOCs in the headspace of the soil sample. The initial (peak) reading must be recorded.

6.7 Record the PID reading in the field notebook, on an appropriate field form, and on the base map, if appropriate.

6.8 Place any material not representative of the interval sampled in a pile with the other cuttings from the borehole.

6.9 If only photoionization results are to be obtained, then reusable sampling devices may be cleaned with a soap and water wash and a potable water rinse. The sampler will then be rinsed with distilled water, assembled and placed on plastic sheeting for reuse. A more rigorous decontamination procedure is required when samples are also being collected for laboratory analysis. Refer to the SOP for collection of soil samples for laboratory analysis for additional information.

END OF PROCEDURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidance to obtain accurate and consistent samples of soil gas.

2.0 MATERIALS/EQUIPMENT

- Teflon or Nylaflow tubing, one-quarter or one-eighth inch diameter sample tubing.
- Swagelok® ¼-inch nut and ferrule sets for connecting the probe tubing to the sampling manifold, as appropriate for the collection method
- Helium leak check equipment, as dictated by Site-specific data quality objectives (DQOs), including the enclosure, helium cylinder (high purity helium), and helium detector (Dialectric MGD is preferred). The enclosure and helium detector may be provided by the driller.
- Air pump for purging and electric supply for the pump (either battery, generator, or power inverter with adapter for car battery). Must be capable of a flow of 200 milliliters per minute (mL/min) and a vacuum of 20" Hg.
- Canister, tedlar bag or syringe, as appropriate for the collection method.

3.0 DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to the decontamination SOP. Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves and plastic sheeting will be changed after each use and discarded in an appropriate manner.

4.0. SITE-SPECIFIC CONSIDERATIONS

Prior to attempting soil gas sampling there should be an understanding of subsurface conditions at the Site. Soil gas samples should be collected in the vadose zone and generally, soil gas samples should not be collected at a depth less than above 5 feet below ground surface (bgs), unless sub-slab soil gas samples are needed. It may also not be feasible to collect soil gas from tighter grain soils with little pore volume, such as clays, and these layers should be avoided.

Soil gas sampling should not be performed until 24-hours after a significant rain event (>1/2 inch of rainfall).

5.0 PROCEDURE

5.1 System Set-up

1. Acquire all the necessary hardware and sampling equipment. Be sure to use one-quarter or one-eighth inch diameter Teflon or Nylaflow sample tubing.

2. Assemble or obtain the necessary fittings and vacuum gauge to create a soil gas probe and sampling manifold (vacuum gauge and valving). This manifold must be clean, free of oils, and flushed free of VOCs prior to use. If appropriate, be sure to place the helium leak check enclosure over the probe, and push the sample tubing through the hole in the cap before attaching the sampling manifold.

3. Adjust the purge system evacuation pump sampling rate to achieve the desired flow rate of 200 mL/min. This should be performed at the outlet of the vacuum pump prior to purging, either by using a suitable flow meter, or determining the amount of time required to fill a 1-liter Tedlar bag.

5.2 Shut-In Test

Prior to purging or sampling, a shut-in test should be conducted to check for leaks in the above-ground sampling system.

1. Assemble the above-ground valves, lines and fittings downstream from the top of the probe.

2. Evacuate the system to a minimum measured vacuum of about 100 inches of water using the purge pump.

3. Observe the vacuum gauge for 1-2 minutes. If there is any observable loss of vacuum, adjust the above-ground sampling system until the vacuum is maintained.

5.3 System Leak Checking and Purging

Perform a leak check of the sample manifold system by:

1. Make sure the gas probe valve is off and the sample valves are closed.

2. Open the purge valve and start the purge pump. Verify that the flow is set to 200 mL/min until a vacuum of approximately 15” Hg is achieved.
3. Turn off the purge pump and observe the vacuum gauge for 1-2 minutes. If there is any observable loss of vacuum, the leaks must be fixed prior to sampling.
4. Record the leak check date and time on the field notebook.

5.4 Purge Volume Test (Mobile Laboratory Only)

The purpose of the purge volume test is to ensure that stagnant air is removed from the sampling system and to ensure that samples are representative of subsurface conditions. The test well should be located where soil gas concentrations are anticipated to be elevated, if possible.

Perform a purge test of the test well by:

1. Purge the well one purge volume and collect a sample.
2. Have the mobile laboratory analyze the sample for target compounds. Sample procedures are explained in Section 5.6, below.
3. Purge an additional two purge volumes (for a total of 3 purge volumes), collect a sample and submit to the mobile laboratory for analysis.
    a. One purge volume is equal to the sum of the following volumes:
        - The internal volume of tubing;
        - The void space of the sand pack around the probe tip;
        - The void space of the dry bentonite in the annular space.
4. Repeat for a purge of 10 total purge volumes.
5. The site purge volume will be chosen based on the sample with the highest concentration of target compounds from the purge test. All of other sample locations will utilize this purge volume (either one, three, or ten).

5.5 Helium Leak Check (as dictated by DQOs)

The helium leak check procedure is accomplished by:

1. Start the flow of helium under the leak check enclosure. Position the tube so the helium is directed at the interface of the probe and the ground. Let the helium fill the enclosure for a couple of minutes.
2. Turn the helium leak detector on and make sure that the detector is not reading any helium before proceeding.

3. Verify that the helium concentration inside the leak check enclosure is >10% by placing the probe of the helium detector into the hole where the sample tubing comes out or under the enclosure wall. It is not necessary to verify that the helium concentration is 100% as this is bad for the detector.

4. Purging is carried out by pulling soil gas through the system at a rate of 200 mL/min for a time period sufficient to achieve three purge volumes, equal to the sum of the internal volume of the in-ground annular space, sample line, and sampling manifold system.

   Note: When calculating the purge volume, be sure to take into account the inside diameter and length of the sample tubing, as well as the probe outside diameter and retract distance for the annular space for temporary probes. If during the purge (or sampling) the vacuum exceeds 7 "Hg, then reduce the pump flow rate. The system vacuum must stay below this level at all times.

5. To start the soil gas probe purge, open the gas probe valve and close the sample valve at the same time, and start timing. Verify that the flow rate is still 200 mL/min.

6. During the last 5 minutes of the purge (or the entire purge time if less than 5 minutes), attach a Tedlar bag to the purge pump exhaust and open the bag's valve.

7. At the end of the purge time, close the purge valve, close the valve to the Tedlar bag, and turn off the pump.

8. Attach the Tedlar bag to the helium detector and open the valve. If a helium reading of greater than or equal to 5% of the helium concentration inside the leak check enclosure is observed, then the probe leak check has failed and corrective action should be taken.

9. Record the purge date, time, purge rate, leak check result, and purge volume on the field sampling log.

10. Immediately move on to the sampling phase. Little to no delay should occur between purging and sampling.

5.6 Sample Collection

'Clean' sampling protocols must be followed when handling and collecting samples. This requires care in the shipping, storage, and use of sampling equipment. Sharpie markers should not be used for labeling or note-taking during sampling.

1. Attach the canister, tedlar bag or syringe to the sample tubing.

2. Before taking the sample, confirm that the sampling system valves are set as follows: the purge valve is confirmed to be closed, gas probe valve is open, and the sample valve is open.

3. After sampling for the appropriate amount of time, close the sample valve and the canister/tedlar bag valve. Remove the sample container from the sampling manifold.

4. Record the sampling date, time, canister identification (ID), flow controller ID, and any other observation pertinent to the sampling event on the field sampling log. The temperature and barometric pressure should be recorded.

5. Fill out all appropriate documentation (sampling forms, sample labels, chain of custody, sample tags, etc.).

6. Disassemble the sampling system.

END OF PROCEDURE

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the considerations and procedures, and to establish the guidelines for drilling (soil borings, wells, or piezometers) and formation sampling activities in unconsolidated formations. There are several drilling techniques available which include: direct push (Geoprobe® or cone penetrometer testing [CPT]), hollow-stem auger, cable tool, hydraulic rotary, cased-hole rotary, air rotary, and Sonic. Formation (sediment/soil) sample collection options include: disturbed (drill cuttings), intact (split-spoon or continuous core), and undisturbed (Shelby-tube or Denison-core). Borehole abandonment (closure) procedures will also be addressed in this SOP.

The objective of drilling is to collect accurate subsurface information. Consequently, the lithologic data is essential information that characterizes subsurface conditions and describes geologic coefficients qualitatively and/or quantitatively.

2.0 DRILLING TECHNIQUE-SELECTION

Verify that the drilling technique is the one specified in the investigation work plan, and that the drilling equipment mobilized by the driller is in good condition and proper working order. Do not permit the driller to use a drilling rig that appears to be substandard, in disrepair, etc., and/or is questionable as to whether or not the rig has the capabilities to accomplish the goals of the drilling program. Complete a drill rig inspection checklist before starting any drilling activities. The drilling rig must be capable of:

a. Penetration of all anticipated subsurface materials and formations at a desired rate, and construction of a borehole of desired diameter.

b. Identification of lithology for development of a geologic log of all unconsolidated formations and materials penetrated, including physical characteristics and visual description of color, grain sizes, sorting and mineralogy.

c. Collection of intact and/or undisturbed soil samples from the center line or sidewall of the borehole. This objective requires the drilling to be halted while soil samples are taken from the bottom or side of the incomplete borehole.

d. Implementation of borehole geophysical logging (when applicable and possible) to enable more accurate vertical and horizontal extrapolation of borehole data to the lithology of the hydrogeologic system.

Drilling will not commence until the following have been completed:

- Development and approval of a drilling specific job safety analysis (JSA)
- a utility mark-out/one call has been conducted at the drilling location(s); and
- the completion of a subsurface clearance procedure checklist.

3.0 DRILLING TECHNIQUE - DESCRIPTION

3.1 Direct Push – The direct push technology includes several types of drilling rigs and drilling equipment that advances a drill string by pushing or hammering without rotating the drill string. Direct push rigs include both Geoprobe® and CPT rigs. Geoprobe® rigs are typically limited to drilling in unconsolidated soil up to approximately 100 feet below ground surface (bgs) under compatible conditions. Formation samples are collected in acetate/plastic sleeves. Advantages include: access and maneuverability due to the rig's small size; fluids are not introduced into the subsurface during drilling; and sampling is relatively inexpensive. Disadvantages include: limitation to drilling depth; limitation to unconsolidated or soft rock drilling; and limitation to small diameter borings. CPT rigs also provide a continuous profile of the soil strata as the rig's sensing equipment is advanced.

3.2 Hollow-Stem Auger - This drilling method is rapid and extremely effective in most cohesive sediments but less so in loose sandy material. A major advantage of this technique is that normally no fluids are introduced into the formation. If the auger flights can be removed and the integrity of the borehole maintained, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If the auger flights must remain in the borehole, then only radiation geophysical logs can be run. Casing, screen, and sampling devices can then be lowered through the hollow stem by removing the removable plug at the bottom of the auger flights, and gravel/sand packing and cementing can be accomplished within the hollow stem. However, this can be difficult especially below the water table. Auger flight outside diameters (OD) range from 5 inches (in.) to 12 in.

3.3 Cable Tool (Percussion) - This drilling method is slow because the borehole is advanced by lifting and dropping a heavy string of drilling tools. Cuttings accumulate in the drill casing and are removed by a sand bailer. A steel casing is driven in as the hole is deepened. Cable-tool rigs can be used in unconsolidated sediment and bedrock to depths of hundreds or thousands of feet and often employ telescoping techniques for drilling deep boreholes. Electrical geophysical logs cannot be run through the steel cased borehole, but radiation logs (e.g., gamma, neutron, etc.) can be run. Well casing and screen can be installed within the cased hole after which the outer casing is pulled back (removed). Because the boring is cased as it is being drilled, cross-contamination between various depths is practically eliminated. The method provides an excellent means to collect good, representative formation samples.

3.4 Hydraulic Rotary - This drilling method uses a rotating bit to drill (advance) the borehole. Drill cuttings are removed using a recirculated drilling fluid (mud or water). Although setting up the drilling equipment is slow, the drilling process is reasonably fast. In the mud-rotary method, drilling mud forms a cake on the borehole wall which prevents excessive loss of fluid to the formation being drilled. The hydrostatic pressure combined with the weight and density of the mud slurry keeps the hole open. This allows the drill rods to be removed from the borehole and geophysical logs (electric and radiation) to be run in the open borehole.

In reverse hydraulic rotary drilling, the drilling fluid moves downward through annular space and then upward inside the drill pipe. If the drilling fluid does not contain mud, then sufficient water flow is required as make-up water because the borehole wall is not sealed; therefore, significant water loss can occur to the formation being drilled. The borehole is held open by hydrostatic pressure only. A serious obstacle to this drilling method occurs when the static water level is less than 15 feet below land surface because of insufficient hydrostatic head difference between the borehole and the water table. However, the problems of excessive water loss and shallow depths to water may be overcome by using mud as the drilling fluid.

In mud-rotary drilling, the drilling fluid (mud or polymer) moves downward through the drill pipe and then upward through the annular space. Therefore, the borehole is held open by hydrostatic pressure and the mud cake lining the wall of the borehole. The mud-rotary method can be used to construct moderate to deep wells in unconsolidated (and consolidated material), while the reverse rotary technique can be used to construct moderate to deep wells in unconsolidated materials. The principal disadvantage may be the difficulty in removing mud cake from the formation at the screened zone. Extensive well development may be required to remove the mud cake.

3.5 Cased-Hole Rotary - Several rotary drilling techniques have been developed in which a steel casing is advanced with an air-rotary or mud-rotary drill. This technique is highly desirable for use in exploratory drilling at monitoring sites because water and soil samples may be collected under conditions which preclude contamination from shallower depths. Furthermore, this technique is extremely effective in boulder or cavernous zones which would inhibit or preclude drilling using other techniques. Drilling results are comparable to cable-tool drilling but with greatly enhanced speeds. In all the cased-hole techniques, the main benefit is that the only portion of the borehole which is open, is at the bottom of the drill casing; thus, no soil or water from shallower depths can move down and impact the depth drilled and/or sampled. Electrical geophysical logs cannot be run through the steel-cased borehole, however, radiation logs (e.g., gamma, neutron, etc.) can be run.

Presently, there are three cased-hole rotary techniques which include:

a. The drill-thru casing hammer technique in which the casing is advanced by percussion with a casing hammer or vibratory driver similar to the method used in a borehole drilled by the air-rotary method. The casing hammer can also pull out the casing (air drilling only).

b. The Odex™ Drilling System (European system) which "pulls" the casing using a fixture attached to an air-hammer type drill bit (air drilling only).

c. The Barber™ Drilling System in which drilling is done with a top-head drive and a rotary table that spins casing into the ground. Casing can be fitted with a carbide "shoe" to cut boulders and an air hammer can be used above the bit. Air or mud rotary can be used to lift cuttings.

Two potential problems may be encountered using the cased-hole rotary technique which include: 1) "sand heave" when drilling stops (which can be quickly drilled or bailed out) and 2) possible aeration of water in the cased borehole if volatiles are being tested (which can be overcome by pumping or bailing the standing water out before sampling). The minimum drill casing diameter is 6 inches and depth is limited to approximately 450 feet.

3.6 Air Rotary - This drilling method uses a rotating bit to drill, and high-velocity compressed air to remove cuttings from the borehole. A pneumatic down-hole hammer is often used to add percussion to the rotary drilling action. This drilling method is very fast and, although it is most suitable for penetrating hard bedrock, it can be used in unconsolidated formations. The borehole may be cased or uncased depending on geologic conditions. If an open borehole is drilled, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If a cased borehole is drilled, then only radiation geophysical logs can be run.

Four potential problems may be encountered when using the air-rotary technique:

a. When a prolific aquifer is tapped, the compressed air may not be able to lift the water to the surface.

b. Aeration of water in the borehole (and finished well) immediately prior to sampling can interfere with a number of inorganic and organic water-quality parameters.

c. Low yield water entry zones may not be identified because the air pressure prevents water from entering the borehole. Care should be taken to prevent overdrilling of the borehole.

d. Air rotary drilling can induce the migration of volatile organics to the surface or adjacent structures causing potential aesthetic or health and safety concerns.

If the air-rotary technique is used then the following special procedures will be implemented:

a. The type of air compressor and lubricating oil will be documented on an appropriate field form and in the field notebook and a 1-pint sample of the oil will be retained for characterization in the event organic compounds are detected in a well sample.

b. An air line oil filter will be required and changed per manufacturer's recommendations during operation with documentation of this maintenance on an appropriate field form and in the field notebook. More frequent oil filter changes will be made if oil is visibly detected in the filtered air.

c. The use of any additive will be prohibited, except approved water (e.g., potable water) for dust control and cuttings removal.

3.7 Sonic - This drilling method uses a rotating bit to drill, and high-frequency resonant vibrations created by a Sonic drill head. The drill head contains the mechanism necessary for rotary motion as well as an oscillator, which causes a high frequency force to be superimposed on the drill string. The frequency can be varied to suit operating conditions and is generally between 50 and 120 hertz (cycles per second). The vibrations are sent down the drill string to the drill bit, magnifying the amplitude of the drill bit, which (in overburden) fluidizes the soil particles at the bit face. The drill bit is physically vibrating up and down in addition to being pushed down and rotated. These three combined forces allow for relatively fast and easy penetration through most geological formations. The oscillator is driven by a hydraulic motor and uses out of balance weights to generate high sinusoidal forces that are transmitted to the drill bit. An internal spring system isolates these vibrational forces from the rest of the drill rig. Typically, Sonic drilling uses a drilling fluid (i.e., potable water) to facilitate the advancement of the drill bit. The amount of drilling fluid used should be limited during soil collection as to minimize wash-out of the sample.

4.0 DECONTAMINATION

Drilling equipment decontamination procedures are outlined in the field equipment decontamination SOP. Proper decontamination in accordance with regulatory guidelines must be clearly documented in the field notebook.

5.0 PROCEDURE FOR DRILLING

5.1 Safety first. Obtain the appropriate work permit, Job Safety Analysis (JSA) and personal protection equipment (PPE), as specified in the site Health and Safety Plan (HASP).

5.2 Document all drilling-related activities (e.g., starting, stopping, footage, problems, decontamination, etc.) on the daily log form and in the field notebook. Record dates and times of activities, and names of Roux Associates personnel providing oversight.

5.3 Monitor and record drill fluid mix, speed of rotation, pressure on the drill fluid, rate of drilling, and length of drill rods or casing in the borehole, as applicable.

5.4 Confirm that the drill rods and core barrel are straight, or discontinue drilling.

5.5 Pay particular attention to the advancement of the boring because differences in the rate of drilling may be indicative of differences in subsurface geologic conditions (e.g., sand and gravel versus clay).

5.6 Maintain a continuous dialogue with the driller to track and keep informed of all drilling activities (e.g., the speed of the drill and drilling pressure, difficult and easy drilling conditions, etc.).

5.7 Collect formation samples as described in accordance with the work plan. Sample jars must be labeled appropriately (e.g., project number and name, site location, boring number, date, sample interval, blow counts, and initials of Roux Associates personnel collecting sample).

5.8 Record geologic information in the soil boring log form and in the field notebook.

5.9 Handle and ship split-spoon sample jars carefully to avoid breakage and handle and ship tubes or cores carefully to prevent disturbance.

6.0 PROCEDURE FOR FORMATION SAMPLING

6.1 Safety first. Obtain the appropriate JSA and PPE, as specified in the site HASP.

6.2 Intact formation sampling will be implemented using continuous core or split-spoon samplers (which are driven), Shelby-tube samplers (which are pushed), or Denison-core samplers (which are rotated) depending on the drilling technique employed. Formation samples will be retained in core barrel liners/tubes or suitable size jars for physical descriptions and potential physical and chemical analysis. The appropriately labeled jars and tubes will be stored in a safe place to avoid breakage, agitation, and over-heating/freezing. Intact formation samples will be collected at specified intervals as described in the work plan. Geologic information will be recorded on a geologic log form on the appropriate field form. Detailed descriptions of the type(s) of intact sample(s) collected, sampling intervals and conditions, and objective(s) of the sample collection will be provided in the work plan.

6.3 Soil cores from the wells drilled at the Site are used for lithologic identification and physical property analysis. Soil core samples will be collected using a direct push continuous core (acetate/PVC liners) or split-spoon sampler (6-inch stainless steel sample containers). The soil core sample intervals will be specified in the work plan.

6.4 Sampling equipment will be decontaminated by steam cleaning and/or a non-phosphate, laboratory-grade and distilled/deionized wash followed by a distilled/deionized water rinse. (Refer to the field equipment decontamination SOP for a detailed description of minimum and special decontamination procedures.) Decontamination of sediment sampling equipment will take place prior to the collection of the first sample and following the collection of each subsequent sample.

7.0 BOREHOLE ABANDONMENT OR CLOSURE

7.1 Safety first. Obtain the appropriate JSA and PPE, as specified in the site HASP.

7.2 Upon the completion of the investigation, boreholes will be abandoned as specified in the workplan.

7.3 For each abandoned borehole, the procedure will be documented in the field notebook.

END OF PROCEDURE

STANDARD OPERATING PROCEDURE 10.4
FOR CONSTRUCTION, DEVELOPMENT AND ABANDONMENT OF MONITORING OR OBSERVATION WELLS IN UNCONSOLIDATED FORMATIONS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the considerations and procedures for constructing ground-water monitoring or observation wells in unconsolidated (e.g., gravel, sand, silt, and clay) formations. Well development and well abandonment (closure) procedures will also be addressed in this SOP. The United States Environmental Protection Agency (USEPA), the United States Geological Survey (USGS), and state regulatory agency procedures will be reviewed and considered in conjunction with the extensive experience of Roux Associates, Inc. (Roux Associates) to determine appropriate well construction and abandonment procedures. Discussions will be held with appropriate agencies to resolve conflicting procedures and finalize well construction or abandonment methods. The well construction plan and, if necessary, abandonment will be detailed in the work plan.

Monitoring wells will be completed in unconsolidated formations for the purposes of measuring ground-water levels and collecting ground-water samples. Ground-water level data will be used to calculate ground-water elevations which will be used, to construct water-level elevation and ground-water flow direction maps to illustrate head and flow relationships. Ground-water samples will be used to quantify water-quality conditions.

Observations wells will be completed in unconsolidated formations for the purpose of collecting water-level data from aquifer tests. Slug tests, step-drawdown tests, and constant-rate pumping tests (refer to the respective SOPs) may be conducted to qualitatively or quantitatively characterize flow system hydraulic parameters and/or intra-aquifer and inter-aquifer hydraulic connection.

2.0 PROCEDURE FOR WELL CONSTRUCTION

The installation of each unconsolidated well will begin immediately after borehole completion (and geophysical logging, if implemented). Once well installation has begun, no breaks in the process will be made until the well has been completed and secured against unauthorized access. In cases of unscheduled delays, such as personal injury, equipment breakdowns or sudden inclement weather, installation will be resumed as soon as practical.

2.1 The well will be constructed of appropriate type and diameter casing and screen (stainless steel and/or PVC) and will be at least 2 inches in diameter to accommodate most water-sampling and water-level measuring devices. However, if the well's purpose is multiple (pumping tests, remote sensing, water-level recorder station, etc.), a larger diameter monitoring well (4 inches, 6 inches, or greater) may be needed to accommodate pumps, floats, or sensors. The preferred minimum diameter for a well is 4 inches because larger diameter wells (greater than 2 inches) facilitate well purging and sampling procedures (e.g., they can accommodate pumps which 2-inch diameter wells may not).

2.2 Fittings (couplings) will not restrict the inside well diameter, as stainless steel casing will be welded and/or flush-joint threaded, and PVC joints will be internally threaded. Glues, solvents, or chemical cleaners will not be used in the construction of the wells. All casings, fittings, and screens will be new material. The well screens will be fabricated and have an inside diameter equal to the well casing. The lengths of casing and screen will be measured and recorded on an appropriate field form and in the field notebook by the field hydrogeologist prior to installation.

2.3 Wells in unconsolidated formations will be installed as described below unless depth to water or total depth require modifying the thickness of emplaced materials.

a. The screen and casing will be lowered into the borehole to the appropriate depth. Screen and casing materials may be either stainless steel or PVC. A bottom plug, well cap, and flush-joint sections will be used.

b. A gravel pack (quartz sand or pea gravel) will be filled in around the screen from a few feet below the bottom of the screen to several feet (approximately 5) above the screen to avoid applying the weight of the casing on the screen. The size of the uniformly graded gravel pack will be selected based on the grain size of the formation material in the screened interval. The placement of the gravel pack may require the use of a tremie pipe.

c. A 1-foot to 3-foot layer of clean, fine-grained silica sand may be placed above the selected gravel pack to isolate the coarse-grained gravel pack (below) from the fine-grained bentonite seal (above). Again, a tremie pipe may be used in the placement of the sand layer.

d. Several feet (approximately 1-3) of bentonite (powder or pellets) will be placed on top of the sand layer to seal the top of the gravel-packed screen zone.

e. The remainder of the annulus will be grouted to within a few feet of land surface. If PVC casing is used for the construction of deep wells, then extreme care must be taken in grouting the annular space in lifts (specified lengths) to avoid deformation of the PVC casing by the heat of curing and/or the weight of the grout. This is especially important if there are large voids which will serve as reservoirs for the grout.

f. A locking steel protective casing or curb box will be set over the well and cemented in place or welded to the steel casing to prevent water from ponding at the top of the well or directly entering the well, and safeguard the well from accidental damage or vandalism.

2.4 Each well will be properly identified with the appropriate information (e.g., local well number, state permit number [if applicable], etc.). The top of the well casing will serve as the measuring point (MP) for ground-water level measurements. The measuring point will be surveyed to the nearest 0.01 foot relative to a common datum (e.g., mean sea level) by trained Roux Associates personnel or a professional, state-licensed surveyor as defined in the work plan.

2.5 If required, well clusters will be constructed. A well cluster is defined as a group of two or more wells, located adjacent to or very near each other, which penetrate different depths of the aquifer or formation. Each well is screened at a different depth to obtain data defining the vertical distribution of water levels and quality in the aquifer or formation. In the event that a well cluster is drilled, then one large-diameter (e.g., 6-inch, 8-inch, 10-inch, etc.) borehole may be drilled and each well in the cluster will be individually cased within that one borehole; however, the preferred method is to drill individual boreholes for each well in the cluster.

2.6 Each well will have a location sketch, a well construction log, and a geologic log showing the casing placement and materials used to fill the annular space between the well casing and borehole. The appropriate log will show the depths of each casing material and discuss the geologic variability at the site. A description of the surface soils and unsaturated zone materials down to and including the water table is required.

The following information, if applicable, will be included on the well log:

a. Project number.

b. Date and initials of scientist documenting the well information.

c. Date and time of construction.

d. Well location.

e. Well and permit numbers.

f. Borehole diameter.

g. Well depth.

h. Casing material.

i. Screen material.

j. Screen slot size and length.

k. Gravel pack type and size (depths from _____ to _____).

l. Sand pack (depths from _____ to _____).

m. Bentonite pellets (depths from _____ to _____).

n. Bentonite grout (depths from _____ to _____).

o. Cement grout (depths from _____ to _____).

p. Ground-surface elevation.

q. Measuring point elevation.

r. Well height above or depth below land surface.

s. Depth where ground water was encountered.

3.0 DESCRIPTION OF WELL DEVELOPMENT

3.1 Before a newly constructed well can be used for water-quality sampling, measuring water levels, or aquifer testing, it must be developed. Well development refers to the procedure used to clear the well and formation around the screen of fine-grained materials (sands, silts, and clays) produced during drilling or naturally occurring in the formation. Well development continues until the well responds to water-level changes in the formation (i.e, a good hydraulic connection is established between the well and formation) and the well produces clear, sediment-free water to the extent practical.

3.2 Depending on the drilling technique used, composition of the formation screened, and well diameter and construction materials, well development may include one or more of the following techniques.

a. Bailing.

b. Pumping (centrifugal, submersible, or air).

c. Backwashing.

d. Surging (mechanical).

e. Jetting.

f. A combination of the above.

3.3 A 1-pint sample of the last water removed during development will be obtained and inspected by the field hydrogeologist for relative clarity to determine whether development is complete. A turbidimeter may be used to evaluate the clarity of the water removed from the well during development (and its use may also be stipulated by a regulatory agency). Well development procedures will be recorded on the well construction log form and in the field notebook.

3.4 Dispersing agents, acids, disinfectants, or other additives will not be used during development nor will they be introduced into the well at any other time unless specifically stipulated in the work plan. During development, water will be removed from the entire column of water standing in the well by periodically lowering and raising the pump intake. Well development will include the rinsing of the interior well casing above the water column in the well using only water from that well.

4.0 WELL ABANDONMENT OR CLOSURE

4.1 Upon the completion of the investigation, a determination will be made whether to maintain the well or to close it (i.e., abandon and seal it). If the client and Roux Associates agree to abandon the well, then the state will be notified and a request will be presented for well abandonment. Upon state approval to seal the well, appropriate state well abandonment forms will be completed. Following state approval, the abandonment of any well will be in accordance with local, state and/or Federal regulations.

4.2 For each abandoned well, the procedure will be documented on an appropriate field form and in the field notebook. Documentation may include, where appropriate, the following:

a. Well designation.

b. Location with respect to the replacement well, if replaced (e.g., 30 ft north and 40 ft west of Monitoring Well MW-1). A location sketch should be prepared.

c. Open depth prior to grouting and any other relevant circumstances (e.g., formation collapse).

d. Well casing left in the borehole by depth, size, and composition.

e. A copy of the geologic log.

f. A revised diagram of the abandoned well using the well construction log form.

g. Additional items left in hole by depth, description, and composition (e.g., lost tools, bailers, etc.).

h. A description and daily quantities of grout used to compensate for settlement.

i The date of grouting.

j. The level of water prior to grouting and the date and time measured.

k. The remaining casing, size, and composition above or below ground surface reported in depths or heights from ground surface.

l. Any other state or local well abandonment reporting requirements.

END OF PROCEDURE

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide guidance for the installation of temporary soil gas probes for the collection of shallow soil gas samples. This SOP should be used where its application is consistent with the project's data quality objectives (DQOs) and in conjunction with the SOP for soil gas collection.

2.0 MATERIALS

- 1/8 to 1/4 inch sampling tubing – metal, nylon, PEEK, Teflon
- Appropriate Fittings
- Bentonite Chips
- Water
- Drilling Apparatus

Note: It is necessary to coordinate the hardware (i.e. size of tubing, fittings, sampling interface assembly, etc.) for the soil gas probe sampling line with the sampling system (i.e. Tedlar bags, Summa canisters, etc.). This step is critical to achieve a leak free system.

3.0 PROCEDURE

Temporary soil gas probe installation procedures are described below to ensure that a quality sample is able to be obtained and to minimize ambient air migrating into the sample. Soil gas wells may be installed using various types of drilling methods, however, some drilling methods can disrupt the surrounding soil gas and will require a longer equilibration time prior to sampling. The steps to installing the temporary point are:

1) Drill a borehole to the required depth as shown on the sample plan or scope of work.

2) Install a 6-12 inches sand pack at the bottom and install the probe tip (with attached tubing) approximately 3-4 inches into the sand pack. Use extra tubing so that sufficient amount (1-2 feet) will be left above ground. Plug the exposed end of the tubing.

3) Install 12 inches of dry granular bentonite on top of the sand pack.

4) Fill the remaining annular space with hydrated bentonite in 6" lifts.

    - If multiple probes depths are to be installed at the same location, the hydrated bentonite shall be installed to the top the next testing interval. Sand pack and the dry bentonite will then be installed as normal.

5) Repair the ground surface to original condition.

6) Secure and mark the tubing at the surface with the location ID and depth.

END OF PROCEDURE

Groundwater Sampling for Emerging Contaminants

July 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 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 ,

The work plan should explicitly describe analysis and reporting requirements.

PFAS sample analysis: Currently, ELAP does not offer certification for PFAS compounds in matrices other than finished drinking water. However, laboratories analyzing environmental samples (ex. 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 groundwater samples due to the ability to achieve 2 ng/L (ppt) reporting limits. If contract labs or work plans submitted by responsible parties indicate that they are not able to achieve similar reporting limits, the project manager should discuss this with a DER chemist. Note: Reporting limits for PFOA and PFOS should not exceed 2 ng/L.

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 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 0.35 µg/l (ppb). Although ELAP offers certification for both EPA Method 8260 SIM and EPA Method 8270 SIM, DER is advising the use of method 8270 SIM. EPA Method 8270 SIM provides a more robust extraction procedure, uses a larger sample volume, and is less vulnerable to interference from chlorinated solvents.

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

Collection of Groundwater Samples for Per- and Polyfluoroalkyl Substances (PFAS) 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 sampling 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) and polypropylene. Additional materials may be acceptable if proven not to contain PFAS. **NOTE: Grunfos pumps and some bladder pumps are known to contain PFAS 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 PFAS materials. Clothing that contains PTFE material (including GORE-TEX®) or that have been waterproofed with PFAS materials must be avoided. Many food and drink packaging materials and "plumbers thread seal tape" contain PFAS.

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 250 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.

PFCs Sampling Checklist

Date: ______________________

Weather (*temp./precipitation*): _______________________ Site Name: ________________________________

Field Clothing and PPE:

☐ No clothing or boots containing Gore-Tex™

☐ All safety boots made from polyurethane and PVC

☐ No materials containing Tyvek®

☐ Field crew has not used fabric softener on clothing

☐ Field crew has not used cosmetics, moisturizers, hand cream, or other related products this morning

☐ Field crew has not applied unauthorized sunscreen or insect repellant

Field Equipment:

☐ No Teflon® or LDPE containing materials on-site

☐ All sample materials made from stainless steel, HDPE, acetate, silicon, or polypropylene

☐ No waterproof field books on-site

☐ No plastic clipboards, binders, or spiral hard cover notebooks on-site

☐ No adhesives (Post-It Notes) on-site

☐ Coolers filled with regular ice only. No chemical (blue) ice packs in possession

Sample Containers:

☐ All sample containers made of HDPE or polypropylene

☐ Caps are unlined and made of HDPE or polypropylene

Wet Weather (as applicable):

☐ Wet weather gear made of polyurethane and PVC only

Equipment Decontamination:

☐ "PFC-free" water on-site for decontamination of sample equipment. No other water sources to be used.

☐ Alconox and Liquinox to be used as decontamination materials

Food Considerations:

☐ No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

If any applicable boxes cannot be checked, the Field Lead shall describe the noncompliance issues below and work with field personnel to address noncompliance issues prior to commencement of that day's work. Corrective action shall include removal of noncompliance items from the site or removal of worker offsite until in compliance.

Describe the noncompliance issues (include personnel not in compliance) and action/outcome of noncompliance:

____

____

____

Field Lead Name: ___________________________________

Field Lead Signature: __________________________________ Time: ______________________

PFC Sampling – Prohibited and Acceptable Items

Prohibited	Acceptable
Field Equipment	
Teflon® containing materials	High-density polyethylene (HDPE) materials
Low density polyethylene (LDPE) materials	Acetate Liners
	Silicon Tubing
Waterproof field books	Loose paper (non-waterproof)
Plastic clipboards, binders, or spiral hard cover notebooks	Aluminum field clipboards or with Masonite
	Sharpies®, pens
Post-It Notes®	
Chemical (blue) ice packs	Regular ice
Field Clothing and PPE	
New cotton clothing or synthetic water resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex™	Well-laundered clothing made of natural fibers (preferable cotton)
Clothing laundered using fabric softener	No fabric softener
Boots containing Gore-Tex™	Boots made with polyurethane and PVC
Tyvek®	Cotton clothing
No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling	**Sunscreens** - Alba Organics Natural Sunscreen, Yes To Cucumbers, Aubrey Organics, Jason Natural Sun Block, Kiss my face, Baby sunscreens that are "free" or "natural" **Insect Repellents** - Jason Natural Quit Bugging Me, Repel Lemon Eucalyptus Insect repellant, Herbal Armor, California Baby Natural Bug Spray, BabyGanics **Sunscreen and insect repellant -** Avon Skin So Soft Bug Guard Plus – SPF 30 Lotion
Sample Containers	
LDPE or glass containers	HDPE or polypropylene
Teflon-lined caps	Unlined polypropylene caps
Rain Events	
Waterproof or resistant rain gear	Gazebo tent that is only touched or moved prior to and following sampling activities
Equipment Decontamination	
Decon 90®	Alconox® and/or Liquinox®
Water from an on-site well	Potable water from municipal drinking water supply
Food Considerations	
All food and drink, with exceptions noted on right	Bottled water and hydration fluids (i.e, Gatorade® and Powerade®) to be brought and consumed only in the staging areas

ATTACHMENT 4

Laboratory's Standard Operating Procedures

Emerging Contaminants - PFAS and 1,4-Dioxane

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %	Surrogate Low	Surrogate High
Groundwater - PFAS (Sacramento Lab)	Fluorinated Alkyl Substances	PFC_IDA	3535_PFC	Perfluorobutanoic acid (PFBA)	375-22-4	2.00	0.350	1.50	ng/L	70	130	30	70	130	30		
				Perfluoropentanoic acid (PFPeA)	2706-90-3	2.00	0.490	1.50	ng/L	66	126	30	66	126	30		
				Perfluorohexanoic acid (PFHxA)	307-24-4	2.00	0.580	1.50	ng/L	66	126	30	66	126	30		
				Perfluoroheptanoic acid (PFHpA)	375-85-9	2.00	0.250	1.50	ng/L	66	126	30	66	126	30		
				Perfluorooctanoic acid (PFOA)	335-67-1	2.00	0.850	1.50	ng/L	64	124	30	64	124	30		
				Perfluorononanoic acid (PFNA)	375-95-1	2.00	0.270	1.50	ng/L	68	128	30	68	128	30		
				Perfluorodecanoic acid (PFDA)	335-76-2	2.00	0.310	1.50	ng/L	69	129	30	69	129	30		
				Perfluoroundecanoic acid (PFUnA)	2058-94-8	2.00	1.10	1.50	ng/L	60	120	30	60	120	30		
				Perfluorododecanoic acid (PFDoA)	307-55-1	2.00	0.550	1.50	ng/L	71	131	30	71	131	30		
				Perfluorotridecanoic acid (PFTriA)	72629-94-8	2.00	1.30	1.50	ng/L	72	132	30	72	132	30		
				Perfluorotetradecanoic acid (PFTeA)	376-06-7	2.00	0.290	1.50	ng/L	68	128	30	68	128	30		
				Perfluorobutanesulfonic acid (PFBS)	375-73-5	2.00	0.200	1.50	ng/L	73	133	30	73	133	30		
				Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2.00	0.170	1.50	ng/L	63	123	30	63	123	30		
				Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	2.00	0.190	1.50	ng/L	68	128	30	68	128	30		
				Perfluorooctanesulfonic acid (PFOS)	1763-23-1	2.00	0.540	1.50	ng/L	67	127	30	67	127	30		
				Perfluorodecanesulfonic acid (PFDS)	335-77-3	2.00	0.320	1.50	ng/L	68	128	30	68	128	30		
				Perfluorooctanesulfonamide (FOSA)	754-91-6	2.00	0.350	1.50	ng/L	70	130	30	70	130	30		
				N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	20.0	3.10	10.0	ng/L	67	127	30	67	127	30		
				N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	20.0	1.90	10.0	ng/L	65	125	30	65	125	30		
				6:2 FTS	27619-97-2	20.0	2.00	10.0	ng/L	66	126	30	66	126	30		
				8:2 FTS	39108-34-4	20.0	2.00	10.0	ng/L	67	127	30	67	127	30		
Groundwater - PFAS (Burlington Lab)	Fluorinated Alkyl Substances	PFC_IDA	3535_IVWT	Perfluorobutanoic acid (PFBA)	375-22-4	2.00	1.00	1.20	ng/L	50	150	30	40	160	30		
				Perfluoropentanoic acid (PFPeA)	2706-90-3	2.00	0.630	1.20	ng/L	50	150	30	40	160	30		
				Perfluorohexanoic acid (PFHxA)	307-24-4	2.00	0.760	1.20	ng/L	70	130	20	40	160	20		
				Perfluoroheptanoic acid (PFHpA)	375-85-9	2.00	0.910	1.20	ng/L	70	130	20	40	160	20		
				Perfluorooctanoic acid (PFOA)	335-67-1	2.00	0.630	1.20	ng/L	70	130	20	40	160	20		
				Perfluorononanoic acid (PFNA)	375-95-1	2.00	0.270	1.20	ng/L	70	130	20	40	160	20		
				Perfluorodecanoic acid (PFDA)	335-76-2	2.00	0.770	1.20	ng/L	70	130	20	40	160	20		
				Perfluoroundecanoic acid (PFUnA)	2058-94-8	2.00	0.530	1.20	ng/L	70	130	20	40	160	20		
				Perfluorododecanoic acid (PFDoA)	307-55-1	2.00	0.590	1.20	ng/L	70	130	20	40	160	20		
				Perfluorotridecanoic acid (PFTriA)	72629-94-8	2.00	0.600	1.20	ng/L	70	130	20	40	160	20		
				Perfluorotetradecanoic acid (PFTeA)	376-06-7	2.00	0.920	1.20	ng/L	70	130	20	40	160	20		
				Perfluorobutanesulfonic acid (PFBS)	375-73-5	2.00	0.490	1.06	ng/L	70	130	20	40	160	20		
				Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2.00	0.800	1.09	ng/L	70	130	20	40	160	20		
				Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	2.00	0.950	1.14	ng/L	50	150	30	40	160	30		
				Perfluorooctanesulfonic acid (PFOS)	1763-23-1	2.00	0.610	1.11	ng/L	70	130	20	40	160	20		
				Perfluorodecanesulfonic acid (PFDS)	335-77-3	2.00	0.900	1.16	ng/L	50	150	30	40	160	30		
				Perfluorooctanesulfonamide (FOSA)	754-91-6	2.00	0.640	1.20	ng/L	50	150	30	40	160	30		
				N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	20.0	1.70	6.40	ng/L	70	130	20	40	160	20		
				N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	20.0	1.50	6.40	ng/L	70	130	20	40	160	20		
				6:2 FTS	27619-97-2	20.0	4.60	6.07	ng/L	50	150	30	40	160	30		
				8:2 FTS	39108-34-4	20.0	2.90	6.13	ng/L	50	150	30	40	160	30		
Groundwater - 1,4-Dioxane (Edison Lab)	Semivolatile Organic Compounds (GC/MS SIM / Isotope Dilution)	8270D_SIM_MS_ID	3510C_LVI	1,4-Dioxane	123-91-1	0.350	0.0160		ug/L	10	200	50	70	130	20		
				1,4-Dichlorobenzene-d4	3855-82-1	0.400	0.00100		ug/L								
				1,4-Dioxane-d8	17647-74-4	0.400			ug/L	10	200	50	10	200	20	10	150

Emerging Contaminants in Soil - TestAmerica

Analysis Group	Method Description	Method Code	Prep Method	Analyte Description	CAS Number	RL	MDL	LOD	Units	LCS - Low	LCS - High	LCS - RPD %	MS - Low	MS - High	MS - RPD %
Solid - PFAS (Sacramento)	Fluorinated Alkyl Substances	PFC_IDA	Shake_Bath_14D	Perfluorobutanoic acid (PFBA)	375-22-4	0.200	0.0280	0.150	ug/Kg	81	133	30	81	133	30
				Perfluoropentanoic acid (PFPeA)	2706-90-3	0.200	0.0770	0.150	ug/Kg	79	120	30	79	120	30
				Perfluorohexanoic acid (PFHxA)	307-24-4	0.200	0.0420	0.150	ug/Kg	75	125	30	75	125	30
				Perfluoroheptanoic acid (PFHpA)	375-85-9	0.200	0.0290	0.150	ug/Kg	76	124	30	76	124	30
				Perfluorooctanoic acid (PFOA)	335-67-1	0.200	0.0860	0.150	ug/Kg	76	121	30	76	121	30
				Perfluorononanoic acid (PFNA)	375-95-1	0.200	0.0360	0.150	ug/Kg	74	126	30	74	126	30
				Perfluorodecanoic acid (PFDA)	335-76-2	0.200	0.0220	0.150	ug/Kg	74	124	30	74	124	30
				Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.200	0.0360	0.150	ug/Kg	74	114	30	74	114	30
				Perfluorododecanoic acid (PFDoA)	307-55-1	0.200	0.0670	0.150	ug/Kg	75	123	30	75	123	30
				Perfluorotridecanoic acid (PFTriA)	72629-94-8	0.200	0.0510	0.150	ug/Kg	43	116	30	43	116	30
				Perfluorotetradecanoic acid (PFTeA)	376-06-7	0.200	0.0540	0.150	ug/Kg	22	129	30	22	129	30
				Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.200	0.0250	0.150	ug/Kg	73	142	30	73	142	30
				Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.200	0.0310	0.150	ug/Kg	75	121	30	75	121	30
				Perfluoroheptanesulfonic Acid (PFHpS)	375-92-8	0.200	0.0350	0.150	ug/Kg	78	146	30	78	146	30
				Perfluorooctanesulfonic acid (PFOS)	1763-23-1	0.500	0.200	0.200	ug/Kg	69	131	30	69	131	30
				Perfluorodecanesulfonic acid (PFDS)	335-77-3	0.200	0.0390	0.150	ug/Kg	54	113	30	54	113	30
				Perfluorooctanesulfonamide (FOSA)	754-91-6	0.200	0.0820	0.150	ug/Kg	62	135	30	62	135	30
				N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	2.00	0.390	1.50	ug/Kg	65	135	30	65	135	30
				N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	2.00	0.370	1.50	ug/Kg	65	135	30	65	135	30
				6:2 FTS	27619-97-2	2.00	0.150	1.50	ug/Kg	65	135	30	65	135	30
				8:2 FTS	39108-34-4	2.00	0.250	1.50	ug/Kg	65	135	30	65	135	30

Solid - 1,4-Dioxane 8270D	Semivolatile Organic Compounds (GC/MS)	8270D	3546												
				1,4-Dioxane	123-91-1	0.100	0.00912		mg/Kg	27	70	30	27	70	30

Title: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometery (GC/MS), SW846 Method 8270D

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Approvals (Signature/Date):

Sylvanus Klusey Organics Operations Manager	6/8/2018 Date	Dan Helfrich Health & Safety Manager	6/8/2018 Date
Carl Armbruster Quality Assurance Manager	6/8/2018 Date	Mark Acierno Laboratory Director	6/8/2018 Date

Diaa Nimer
SVOA GC/MS Manager

6/8/2018
Date

Facility Distribution No. : Electronic **Distributed To:** Facility Intranet

1.0 Scope and Application

1.1 Analytes, Matrix(s), and Reporting Limits

USEPA Method 8270D is an analytical method which employs the use of GC/MS to determine the concentration of semivolatile organic compounds in extracts prepared from many types of solid waste matrices, soils, and water samples. TestAmerica Edison has the capability to analyze and report the compounds listed in Table 1 via Method 8270D.

Table 1

Compound	CAS No.	Compound	CAS No.
1,1'-Biphenyl	92-52-4	Anthracene **(1)**	120-12-7
1,2,4,5-Tetrachlorobenzene	95-94-3	Atrazine	1912-24-9
1,2,4-Trichlorobenzene	120-82-1	Benzaldehyde	100-52-7
1,2-Dichlorobenzene	95-50-1	Benzidine	92-87-5
1,2-Diphenylhydrazine	122-66-7	Benzo[a]anthracene **(1)**	56-55-3
1,3-Dichlorobenzene	541-73-1	Benzo[a]pyrene **(1)**	50-32-8
1,3-Dimethylnaphthalene	575-41-7	Benzo[b]fluoranthene **(1)**	205-99-2
1,4-Dichlorobenzene	106-46-7	Benzo[g,h,i]perylene **(1)**	191-24-2
1,4-Dichlorobenzene-d4 **(ISTD)**	3855-82-1	Benzo[k]fluoranthene **(1)**	207-08-9
1,4-Dioxane **(1) (2)**	123-91-1	Benzoic acid	65-85-0
1-Methylnaphthalene	90-12-0	Benzyl alcohol	100-51-6
1-Naphthylamine	134-32-7	Bis(2-chloroethoxy)methane	111-91-1
2,2'-oxybis[1-chloropropane]	108-60-1	Bis(2-chloroethyl)ether **(1)**	111-44-4
2,3,4,6-Tetrachlorophenol	58-90-2	Bis(2-ethylhexyl) phthalate	117-81-7
2,3,7,8-TCDD	1746-01-6	Bisphenol-A	80-05-7
2,3-Dihydroindene	496-11-7	Butyl benzyl phthalate	85-68-7
2,3-Dimethylaniline	87-59-2	Caprolactam	105-60-2
2,4,5-Trichlorophenol	95-95-4	Carbamazepine	298-46-4
2,4,5-Trimethylaniline	137-17-7	Carbazole	86-74-8
2,4,6-Tribromophenol **(Surrogate)**	118-79-6	Chrysene **(1)**	218-01-9
2,4,6-Trichlorophenol	88-06-2	Chrysene-d12 **(ISTD)**	1719-03-5
2,4-Dichlorophenol	120-83-2	Coumarin	91-64-5
2,4-Dimethylphenol	105-67-9	Dibenz(a,h)anthracene **(1)**	53-70-3
2,4-Dinitrophenol	51-28-5	Dibenzofuran	132-64-9
2,4-Dinitrotoluene	121-14-2	Diethyl phthalate	84-66-2
2,4-Xylidine	95-68-1	Dimethyl phthalate	131-11-3
2,6-Dinitrotoluene	606-20-2	Di-n-butyl phthalate	84-74-2
2-Chloronaphthalene	91-58-7	Di-n-octyl phthalate	117-84-0
2-Chlorophenol	95-57-8	Fluoranthene **(1)**	206-44-0
2-Ethylaniline	578-54-1	Fluorene **(1)**	86-73-7
2-Fluorobiphenyl **(Surrogate)**	321-60-8	Hexachlorobenzene **(1)**	118-74-1
2-Fluorophenol **(Surrogate)**	367-12-4	Hexachlorobutadiene	87-68-3
2-Methylnaphthalene	91-57-6	Hexachlorocyclopentadiene	77-47-4
2-Methylphenol	95-48-7	Hexachloroethane	67-72-1
2-Naphthylamine	91-59-8	Indeno[1,2,3-cd]pyrene **(1)**	193-39-5
2-Nitroaniline	88-74-4	Isophorone	78-59-1
2-Nitrophenol	88-75-5	n,n'-Dimethylaniline	121-69-7
2-tertbutyl-4-methylphenol	2409-55-4	Naphthalene **(1)**	91-20-3
2-Toluidine	95-53-4	Naphthalene-d8 **(ISTD)**	1146-65-2
3 & 4 Methylphenol	15831-10-4	n-Decane	124-18-5

Table 1

Compound	CAS No.	Compound	CAS No.
3,3'-Dichlorobenzidine	91-94-1	Nitrobenzene	98-95-3
3,4-Dimethylaniline	95-64-7	Nitrobenzene-d5 **(Surrogate)**	4165-60-0
3,5-di-tert-butyl-4-hydroxytol	128-37-0	N-Nitrosodimethylamine **(1)**	62-75-9
3-Nitroaniline	99-09-2	N-Nitrosodi-n-propylamine	621-64-7
4,6-Dinitro-2-methylphenol **(1)**	534-52-1	N-Nitrosodiphenylamine	86-30-6
4-Bromophenyl phenyl ether	101-55-3	n-Octadecane	593-45-3
4-chloro-2-methylaniline	95-69-2	o-Toluidine-d9 **(Surrogate)**	194423-47-7
4-Chloro-3-methylphenol	59-50-7	Pentachloronitrobenzene	82-68-8
4-Chloroaniline	106-47-8	Pentachlorophenol **(1)**	87-86-5
4-Chloroaniline–d4 **(Surrogate)**	191656-33-4	Perylene-d12 **(ISTD)**	1520-96-3
4-Chlorophenyl phenyl ether	7005-72-3	Phenanthrene **(1)**	85-01-8
4-Methylphenol	106-44-5	Phenanthrene-d10 **(ISTD)**	1517-22-2
4-Nitroaniline	100-01-6	Phenol	108-95-2
4-Nitrophenol	100-02-7	Phenol-d5 **(Surrogate)**	4165-62-2
Acenaphthene **(1)**	83-32-9	Phenyl ether	101-84-8
Acenaphthene-d10 **(ISTD)**	15067-26-2	Pyrene **(1)**	129-00-0
Acenaphthylene **(1)**	208-96-8	Pyridine	110-86-1
Acetophenone	98-86-2	Terphenyl-d14 **(Surrogate)**	1718-51-0
Aniline	62-53-3	Total Cresols	STL00160
Aniline-d5 **(Surrogate)**	4165-61-1		

(1) Compound can be analyzed by full scan or Selected Ion Monitoring (SIM).
(2) Compound can also be analyzed by Isotope Dilution/SIM.

1.2 For a listing of method detection limits (MDLs) and Reporting Limits (RLs) please refer to the currently active Method 8270D Method Limit Groups in TALS (TestAmerica LIMS).

1.3 On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in Section 7 (*Review of Work)*, and Section 19 (*Test Methods and Method Validation)* in TestAmerica Edison's Quality Assurance Manual (TestAmerica Edison Document No. ED-QA-LQM).

2.0 Summary of Method

2.1 This method is used for the analysis of aqueous and solid matrices for semi-volatile base, neutral and acid organic compounds that are extracted from the sample matrix with an organic solvent.

2.2 An aliquot of sample containing surrogate spiking compounds is extracted with an organic solvent. The extract is concentrated on a steam bath to a suitable volume. Internal standards are added to the extract.

2.3 Sample extraction techniques are specified for each matrix in the following TestAmerica Edison SOPs:

- ED-ORP-002 (*Extraction of Semivolatile Organic Compounds in Water by Separatory Funnel, SW846 Method 3510C*);

- ED-ORP-043 (*SW846 Method 3580A - Waste Dilution Prep for Analysis of BNAs by SW846 Method 8270)*
- ED-ORP-0044 (*Microwave Extraction for Solids, SW846 Method 3546*);
- ED-ORP-006 (*Extraction of Semivolatile Compounds in Soil Using Medium Level Extraction Techniques, SW846 Method 3550B)*.

2.4 A small aliquot of the extract is injected into a gas chromatograph (GC) equipped with a capillary column. The GC is temperature programmed to separate the compounds which were recovered during the extraction step by boiling point. The effluent of the gas chromatograph is interfaced to a mass spectrometer (MS) which is used to detect the compounds eluting from the GC. The detected compounds are fragmented with an electron beam to produce a mass spectrum which is characteristic of the compound introduced into the MS. Identification of target analytes is accomplished by comparing their mass spectra with the electron ionization spectra of authentic standards. Quantitation is accomplished by comparing the response of a major ion (quantitation ion) relative to an internal standard established through a five-point calibration (six points for second order regression). Specific calibration and quality control steps are included in the method that must be performed and must meet the specifications of SW846 Method 8270D.

2.5 Standard procedure involves preparation of aqueous samples using a Reduced Volume Extraction (RVE) followed by analysis using a Large Volume Injection (LVI). Optionally, a full volume (1000 ml nominal) may be employed. The details of the extractions are outlined in the applicable prep SOPs while the analytical details for 8270D are presented in this SOP.

2.6 This method is also applicable to the analysis of samples by Selected Ion Monitoring (SIM) for the purpose of obtaining lower reporting limits for the following compounds:

**Table 2 –
SIM Analytes**

SIM Analytes	CAS #
1,4-Dioxane	123-91-1
4,6-Dinitro-2-methylphenol	534-52-1
Acenaphthene	83-32-9
Acenaphthylene	208-96-8
Anthracene	120-12-7
Benzo[a]anthracene	56-55-3
Benzo[a]pyrene	50-32-8
Benzo[b]fluoranthene	205-99-2
Benzo[g,h,i]perylene	191-24-2
Benzo[k]fluoranthene	207-08-9
Bis(2-chloroethyl)ether	111-44-4
Chrysene	218-01-9

**Table 2 –
SIM Analytes**

SIM Analytes	CAS #
Dibenz(a,h)anthracene	53-70-3
Fluoranthene	206-44-0
Fluorene	86-73-7
Hexachlorobenzene	118-74-1
Indeno[1,2,3-cd]pyrene	193-39-5
Naphthalene	91-20-3
N-Nitrosodimethylamine	62-75-9
Pentachlorophenol	87-86-5
Phenanthrene	85-01-8
Pyrene	129-00-0

2.7 An isotope dilution selected ion monitoring (SIM) technique for the analysis of 1,4-dioxane in water at a reporting level of 0.4 ug/l is also described in this SOP. Using this technique 1,4-dioxane-d8 is added prior to sample extraction and is used as an internal standard to calculate the concentration of 1,4-dioxane present. Additionally, 1,4-dichorobenzene-d4 is added to the extract prior to analysis to monitor the recovery of 1,4-dioxane-d8.

3.0 Definitions

For a complete list of definitions refer to Appendix 2 in the most current revision of the Quality Assurance Manual (ED-QA-LQM).

4.0 Interferences

4.1 GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Analysts must take steps to determine the source of the interference and take corrective action to eliminate the problem.

4.1.1 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe is automatically rinsed with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of a solvent blank to check for cross-contamination. Alternately, verify that the sample analyzed after the high concentration sample does not show any carryover through inspection of chromatogram and target results.

4.1.2 Contaminants from the extraction process, detected in the method blank should be evaluated to determine the impact on the analysis. Interferences from any target analyte must not be present in the method blank above the reporting limit for that compound. If these types of interferences occur, corrective action is required. The source should be identified and corrective action initiated to eliminate the interference from the extraction process. Affected samples must be re-extracted and re-analyzed.

4.1.3 The analyst must take precautions to make sure that contaminants do not enter the analytical system. These precautions include systematic procedures designed to eliminate interferences.

4.2 Some compounds analyzed by this method are unstable or sensitive. Benzidine, for example, is easily oxidized during extraction. Hexachlorocyclopentadiene breaks down photochemically and can decompose from high temperatures, particularly in the injection port of the GC. 1,2-Diphenylhydrazine is unstable even at room temperature and readily converts to azobenzene. Phenols are sensitive to active sites and can give a low response or exhibit poor chromatography by tailing. Therefore, it is important the GC is maintained in the best possible condition. See Section 10.1 for proper daily maintenance.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1. Specific Safety Concerns or Requirements

The gas chromatograph and mass spectrometer contain zones that have elevated temperatures. The analyst needs to be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

The mass spectrometer is under deep vacuum. The mass spectrometer must be brought to atmospheric pressure prior to working on the source.

There are areas of high voltage in both the gas chromatograph and the mass spectrometer. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

5.2. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. **Note: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the MSDS for each of the materials listed in the table.** A complete list of materials used in the method can be found in the reagents and materials section.

Employees must review the information in the MSDS for each material before using it for the first time or when there are major changes to the MSDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and symptoms of exposure
Methanol	Flammable Poison Irritant	200 ppm-TWA	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Methylene Chloride	Carcinogen Irritant	25 ppm-TWA 125 ppm-STEL	Causes irritation to respiratory tract. Has a strong narcotic effect with symptoms of mental confusion, light-headedness, fatigue, nausea, vomiting and headache. Causes irritation, redness and pain to the skin and eyes. Prolonged contact can cause burns. Liquid degreases the skin. May be absorbed through skin.
Toluene	Flammable Poison Irritant	200 ppm-TWA 300 ppm-Ceiling	Inhalation may cause irritation of the upper respiratory tract. Symptoms of overexposure may include fatigue, confusion, headache, dizziness and drowsiness. Peculiar skin sensations (e. g. pins and needles) or numbness may be produced. Causes severe eye and skin irritation with redness and pain. May be absorbed through the skin.
Dimethyl-dichloro-silane	Flammable	none	Can be corrosive to the respiratory tract causing severe irritation and tissue damage. Harmful if absorbed through the skin. May cause severe irritation and systemic damage. Severely irritating to the skin and eyes. Harmful if swallowed. Can cause abdominal discomfort, nausea, vomiting, diarrhea, and irritation to the mouth, throat and stomach.
1 – Always add acid to water to prevent violent reactions.			
2 – Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 Equipment and Supplies

6.1 Gas chromatograph/mass spectrometer system

6.1.1 Gas chromatograph: An Agilent/HP 5890/6890/7890 (or equivalent) houses the capillary column. The GC provides a splitless injection port and allows the column to be directly coupled to the mass spectrometer. The oven is temperature programmable to meet the requirements of the method. An HP 7673/7683 autosampler (or equivalent) with a 10 ul syringe provides automatic injection of sample extracts while the instrument is unattended.

6.1.2 Analytical Column: 30m x 0.25mm ID, 0.25 um film thickness, Restek Rxi-5Sil MS, Catalog #13623 Zebron ZB-Semivolatiles, Catalog # 7HG-G027-11.

6.1.3 Mass spectrometer: Agilent (HP) 5972, 5973, 5975 or 5977A Mass Selective Detector (MSD) Capable of scanning from 35 to 500 amu every 1 sec or less, using 70 volts electron energy in the electron ionization mode. The mass spectrometer must be capable of producing a mass spectrum for 50 ng of decafluorotriphenylphosphine (DFTPP) which meets the criteria in Section 9.2.1 when 2 ul of the 25 ug/ml GC/MS tuning standard is injected through the GC.

6.1.4 GC/MS interface: Any GC-to-MS interface may be used that gives acceptable calibration points at 50 ng per injection for each compound of interest and achieves acceptable tuning performance criteria.

6.1.5 Data system: The data system is interfaced to the mass spectrometer and accommodates continuous acquisition and storage of GC/MS data throughout the duration of the chromatographic program. The data system consists of a Hewlett-Packard Chemstation equipped with Mustang software used for instrument control and data acquisition. This, in turn, is interfaced to TestAmerica's Chrom software for data processing. Data from sample extract analysis can be accessed in real-time, while sample data reports and library searches can be performed on data files from previously run samples. The software is also capable of searching any GC/MS data file for ions of a specific mass whose abundances can be plotted versus time or scan number which allows integration of abundances for any extracted ion between specified times or scan-number limits. Library searches utilize a NIST 02.1 Mass Spectral Library.

6.2 Bottles, glass with polytetrafluoroethylene (PTFE)-lined screw caps or crimp tops.

6.3 Injection port liners, splitless

6.4 Injection port septa

6.5 Injection port graphite seals

6.6 Pre-silanized glass wool (Supelco 2-0411 or equivalent)

6.7 Syringes, Assorted sizes 10ul - 1000ul; gas-tight

6.8 Bottles, 10 and 5ml amber screw cap with Teflon liner

6.9 Vials, 2ml amber screw cap with Teflon liner

6.10 Wheaton microvials 100ul (or equivalent)

6.11 Volumetric Flasks, Class A with ground glass stoppers (2ml - 100ml)

6.12 Analytical balance, ASP Model SP-180 (or equivalent), capable of accurately weighing to 0.0001 gr.

7.0 Reagents and Standards

7.1. Reagents:

7.1.1. Methylene Chloride: J.T.Baker Resi-Analyzed, used for Organic Residue Analysis (P/N 9266-V8 or equivalent).

7.1.2. Methanol: J.T.Baker Purge and Trap Grade (P/N 9077-02 or equivalent).

7.1.3. Toluene: J.T.Baker Resi-Analyzed, for Organic Residue Analysis (P/N 9460-03 or equivalent).

7.1.4. Sylon-CT: Supelco (P/N 33065-U or equivalent). Sylon-CT is a highly reactive silanizing reagent consisting of 95% Toluene and 5% Dimethyldichlorosilane (DMDCS).

7.1.5. Each lot of solvent is screened for contaminants before being used for analysis as detailed in TestAmerica Corporate Quality SOP No. CA-Q-S-001 (*Solvent & Acid Lot Testing & Approval*) and TestAmerica Edison SOP No. ED-GEN-023 (*Bulk Solvent Testing and Approval*).

7.2. Standards:

7.2.1. Calibration Standards (Full Scan Analysis): Stock analytical standard solutions are purchased mainly from Restek Corporation. Other standards are prepared in the laboratory as needed using neat compounds or prepared solutions purchased from SPEX CertiPrep, Chem Service, Accustandard, Supelco or other suppliers. Standards prep instructions are detailed for the following full scan analyte list options:

- Full Volume Aqueous Prep and Soils – Long Analyte List
- Full Volume Aqueous Prep and Soils – Short Analyte List
- Full Volume Aqueous Prep and Soils – Aromatic Amines
- Reduced Volume Aqueous Prep and Soils – Long Analyte List
- Reduced Volume Aqueous Prep and Soils – Short Analyte List
- Reduced Volume Aqueous Prep and Soils – Aromatic Amines

Secondary dilutions are either made from purchased stock solutions as listed below or from prepared solutions as listed in the following table:

NOTE: Second sources (from certified separate lots) are used for ICV standards.

Table 3 –
Full Scan Stock Standards

Target Analyte Standard Name	Conc. (PPM)	Vendor	Catalog #
1,2,3,4-TCDD	50	SPEX	SVO-TANJ-12
SPEX Super Mix (contains compounds listed in table below)	2000 *	SPEX	SVO-TANJ-16
8270 List 1/ Std #1 Megamix	Varied	Restek	567672
8270 List 1/ Std #7 N-Diphenylamine	2000	Restek	567676
8270 List 1/ Std #8	2000	Restek	568724
8270 Surrogate Standard	5000*	Restek	567685
8270 Internal Standard	2000	Restek	567684
8270 List 1/ Std#2 Amines	2000	Restek	567673
Custom Aromatic Amine Mix (see Table 5 below)	2000	Supelco	21892423
Custom Aromatic Amine Surrogate Standard (see Table 17A)	2000	Restek	569641
Bisphenol-A	1000	SPEX	S-509-MC

*SPEX Super Mix and 8270 Surrogate standard are diluted to 100ppm prior to the preparation of the 1.0ppm and 0.5ppm standards.

Table 4
SPEX Super Mix
SPEX Catalog No. SVO-TANJ-16

Analyte	Concentration (PPM)
Pentachloronitrobenzene	2000
2 -tert-butyl-4-Methylphenol	2000
2,6-Di-tert-butyl-4-Methylphenol	2000
Coumarin	2000
Phenyl ether	2000
N,N’-Dimethylaniline	2000
N-Methylaniline	2000
Carbamazepine	2000
Benzonitrile	2000
1,3-Dimethylnaphthalene	2000

Table 5 Supelco Custom Aromatic Amine Mix Catalog No. 2168334	
Analyte	**Concentration (PPM)**
Aniline	2000
o-Toluidine	2000
2-Ethylaniline	2000
2,4-Dimethylaniline	2000
3,4-Dimethylaniline	2000
2,3-Dimethylaniline	2000
2,4,5-Trimethylaniline	2000
4-Chloro-o-Toluidine	2000
4-Chloroaniline	2000
2-Naphthylamine	2000

7.2.1.1. Individual calibration standards for full scan analysis are prepared in one of several ways depending upon the technique (full volume aqueous prep, soils prep, reduced volume prep with LVI) as well as the target analyte list (long list, short list, aromatic amines). The following tables detail the preparation of calibration standard solutions for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 6
Full Volume Aqueous Prep and Soils – Long Analyte List
Working Standards Preparation

Solution Name	120 PPM	80 PPM	50 PPM	20 PPM	10 PPM	5 PPM	1 PPM	0.5 PPM
8270 List 1/ Std #1 Megamix	1200ul	800ul	500ul	200ul	100ul	50ul	10ul	5ul
8270 List 1/ Std #7	600ul	400ul	250ul	100ul	50ul	25ul	-	-
8270 List 1/ Std #8	600ul	400ul	250ul	100ul	50ul	25ul	-	-
SPEX Super Mix	600ul	400ul	250ul	100ul	50ul	25ul	100ul*	50ul*
1,2,3,4-TCDD	-	-	100ul	-	-	-	-	-
8270 Surrogate Standard	240ul	160ul	100ul	40ul	20ul	10ul	100ul*	50ul*
8270 Internal Standard	200ul	200ul	200ul	200ul	200ul	200ul	200ul	200ul
Bisphenol-A	600ul	400ul	250ul	100ul	50ul	25ul		
Final Volume (ml)	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**

Note: The 1.0ppm and 0.5pmm standards (above) are prepared using the 100ug/ml standard for Spex Super Mix and 8270 Surrogate Standard.

Table 7
Full Volume Aqueous Prep and Soils – Short Analyte List
Working Standards Preparation

Solution Name	120 PPM	80 PPM	50 PPM	20 PPM	10 PPM	5 PPM
8270 Internal Standard	200ul	200ul	200ul	200ul	200ul	200ul
8270 List 1/ Std#8	600ul	400ul	250ul	100ul	50ul	25ul
Final Volume (ml)	**10**	**10**	**10**	**10**	**10**	**10**

Table 8
Full Volume Aqueous Prep and Soils - Aromatic Amines
Working Standards Preparation

Solution Name	120 PPM	80 PPM	50 PPM	20 PPM	10 PPM	0.5 PPM
8270 Internal Standard	200ul	200ul	200ul	200ul	200ul	200ul
Custom Aromatic Amine Mix	600ul	400ul	250ul	100ul	50ul	2.5ul
Custom Aromatic Amine Surrogate Std	600ul	400ul	250ul	100ul	50ul	2.5ul
Final Volume (ml)	**10**	**10**	**10**	**10**	**10**	**10**

Table 9
Reduced Volume Extraction/LVI – Long Analyte List
Working Standards Preparation

Solution Name	24 PPM	16 PPM	10 PPM	4 PPM	2 PPM	1 PPM	0.2 PPM	0.1 PPM
120 ppm Long Cal Std (see Table 6)	1.0 mL							
80 ppm Long Cal Std (see Table 6)		1.0 mL						
50 ppm Long Cal Std (see Table 6)			1.0 mL					
20 ppm Long Cal Std (see Table 6)				1.0 mL				
10 ppm Long Cal Std (see Table 6)					1.0 mL			
5.0 ppm Long Cal Std (see Table 6)						1.0 mL		
1.0 ppm Long Cal Std (see Table 6)							1.0 mL	
0.5 ppm Long Cal Std (see Table 6)								1.0 mL
Final Volume (ml)	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**

Table 10
Reduced Volume Extraction/LVI – Short Analyte List
Working Standards Preparation

Solution Name	24 PPM	16 PPM	10 PPM	4 PPM	2 PPM	1 PPM
120 ppm Short Cal Std (see Table 7)	1.0 ml					
80 ppm Short Cal Std (see Table 7)		1.0 ml				
50 ppm Short Cal Std (see Table 7)			1.0 ml			
20 ppm Short Cal Std (see Table 7)				1.0 ml		

Table 10
Reduced Volume Extraction/LVI – Short Analyte List
Working Standards Preparation

Solution Name	24 PPM	16 PPM	10 PPM	4 PPM	2 PPM	1 PPM
10 ppm Short Cal Std (see Table 7)					1.0 ml	
5.0 ppm Short Cal Std (see Table 7)						1.0 ml
Final Volume (ml)	**5**	**5**	**5**	**5**	**5**	**5**

Table 11
Reduced Volume Extraction/LVI -Aromatic Amine
Working Standards Preparation

Solution Name	24 PPM	16 PPM	10 PPM	4 PPM	2 PPM	0.1 PPM
120 ppm Aromatic Amines Cal Std (see Table 8)	1.0 ml					
80 ppm Aromatic Amines Cal Std (see Table 8)		1.0 ml				
50 ppm Aromatic Amines Cal Std (see Table 8)			1.0 ml			
20 ppm Aromatic Amines Cal Std (see Table 8)				1.0 ml		
10 ppm Aromatic Amines Cal Std (see Table 8)					1.0 ml	
0.5 ppm Aromatic Amines Cal Std (see Table 8)						1.0 ml
Final Volume (ml)	**5**	**5**	**5**	**5**	**5**	**5**

7.2.1.2. **Initial Calibration Verification (full scan)**: Second source ICVs for full scan analysis are prepared in one of several ways depending upon the technique (full volume aqueous prep, soils prep, reduced volume prep with LVI) as well as the target analyte list (long list, short list, aromatic amines). The following tables detail the preparation of ICVs for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 12
8270/625 ICV -Long List
Working Standards Preparation

Solution Name	25 PPM
8270 List 1/ Std #1 Megamix (2nd Lot)	250ul
8270 List 1/ Std #7 (2nd Lot)	125ul
8270 List 1/ Std #8 (2nd Lot)	125ul
SPEX Super Mix (2nd Lot)	125ul
8270 Internal Standard	200ul
Bisphenol-A (2nd Lot)	125ul
Final Volume (ml)	**10**

Table 13 8270/625 ICV - Short List Working Standards Preparation	
Solution Name	**25 PPM**
8270 Internal Standard (2nd Lot)	200ul
8270 List 1/ Std#2 Amines (2nd Lot)	125ul
Final Volume (ml)	**10**

Table 14 Aromatic Amines ICV Working Standards Preparation	
Solution Name	**25 PPM**
8270 Internal Standard	200ul
Supelco Aromatic Amines 2nd Lot (Cat. No. 21467482)	125ul
Final Volume (ml)	**10**

Table 15 8270/625 ICV LVI - Long List Working Standards Preparation	
Solution Name	**5 PPM**
25PPM 8270/625 ICV (Long List) (see Table 12)	1.0 mL
Final Volume (ml)	**5**

Table 16 8270/625 ICV LVI -Short List Working Standards Preparation	
Solution Name	**5 PPM**
25PPM 8270/625 ICV (Short List) (see Table 13)	1.0 mL
Final Volume (ml)	**5**

7.2.1.3. **Surrogate Standards (Full Scan Analysis):** A 5000ppm Surrogate Standard is purchased from Restek for use in spiking blanks, samples and associated QC prior to extraction (reference the applicable sample prep SOPs for spiking instructions).

Table 17
Full Scan Surrogate Standards Solution
Restek Catalog No. 567685

Surrogate Standard Compounds	Concentration (PPM)
Nitrobenzene-d5	5000
p-Terphenyl-d14	5000
2,4,6-Tribromophenol	5000
Phenol-d5	5000
2-Fluorobiphenyl	5000
2-Fluorophenol	5000

7.2.1.3.1 **Surrogate Standards (Aromatic Amine Analysis):** A 2000 ppm Surrogate Standard is purchased from Restek (Cat. # 569641) for use in spiking blanks, samples and associated QC prior to extraction and analysis of samples for Aromatic Amines (reference the applicable prep SOPs for spiking instructions).

Table 17a
Aromatic Amine Surrogate Standards Solutions
Restek Catalog Nos. 569641

Surrogate Standard Compounds	Concentration (PPM)
Aniline-d5	5000
o-Toluidine-d9	5000
4-Chloroaniline-d4	5000

7.2.1.4. **Internal Standards** (**Full Scan Analysis**): The Internal Standards Solution at 2000ppm is purchased from Restek (Catalog # 567684). The Internal Standard solution is stored in 10ml amber screw cap bottles with Teflon liners in the dark at 4^{o}C. The Internal standard solution is used in preparing all analytical standards. Inject 20ul of this solution (2000ppm) per ml of sample extract prior to analysis resulting in a concentration of 40ppm (ug/ml) in the extract.

Table 18
Full Scan Internal Standards Solution
Restek Catalog No. 567684

Internal Standard Compounds	Concentration (PPM)
1,4-Dichlorobenzene-d4	2000
Phenanthrene-d10	2000
Naphthalene-d8	2000
Chrysene-d12	2000
Acenaphthene-d10	2000

Table 18 Full Scan Internal Standards Solution Restek Catalog No. 567684	
Internal Standard Compounds	**Concentration (PPM)**
Perylene-d12	2000

7.2.2. Calibration Standards (SIM analysis): The Edison lab currently analyzes only a select list of compounds by 8270D SIM (see Sections 1.0 and 2.0). Stock analytical SIM standard solutions are purchased mainly from Accustandard and Spex. Working standards are prepared from these solutions as listed in the tables in Section 7.2.2.1:

Table 19- Stock SIM Standards			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
Pentachlorophenol	100ppm	Accustandard	App-9-176
n-Nitrosodimethylamine	100ppm	Accustandard	APP-9-149
Hexachlorobenzene	100ppm*	Accustandard	APP-9-112
PAH Mix	100ppm	Accustandard	M-610
Bis(2-chloroethyl)ether	100ppm*	Accustandard	App-9-027
4,6-Dinitro-2-methylphenol	100ppm	Accustandard	P-3845
1,4-Dioxane	1000ppm**	Accustandard	APP-9-096

*Hexachlorobenzene and Bis(2-chloroethyl)ether are diluted to 10ppm prior to SIM Standards prep

** 1,4-Dioxane is diluted (10x) to 100ppm prior to SIM Standards prep

NOTE: Second sources (from separate lots are used for ICV standards).

7.2.2.1 Individual calibration standards for SIM analysis are prepared in one of two ways depending upon the technique (full volume aqueous prep or reduced volume prep with LVI) as well as the target analyte list (long list, short list, aromatic amines). The following tables detail the preparation of calibration standard solutions for each of these techniques and analyte lists. Prepare by combining the indicated volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 20 Full Volume Aqueous Prep – SIM Working Standards Preparation						
	0.025 PPM	**0.05 PPM**	**0.1 PPM**	**0.5 PPM**	**1.0 PPM**	**5.0 PPM**
Pentachlorophenol	10uL	25uL	50uL	50uL	100uL	250uL
n-Nitrosodimethylamine	10uL	25uL	50uL	50uL	100uL	250uL
PAH mix	2.5uL	5uL	100uL	25uL	50uL	100uL

Table 20
Full Volume Aqueous Prep – SIM
Working Standards Preparation

	0.025 PPM	**0.05 PPM**	**0.1 PPM**	**0.5 PPM**	**1.0 PPM**	**5.0 PPM**
Hexachlorobenzene	10uL	25uL	100uL	500uL	1000uL	2500uL
Bis(2-chloroethyl)ether	10uL	25uL	100uL	500uL	1000uL	250uL*
4,6-dinitro-2-methylphenol	50ul	100ul	200ul	200ul	250ul	500ul
1,4-Dioxane	20ul	50ul	100ul	100ul	200ul	500ul
ISTD	200uL	200uL	200uL	100uL	100uL	100uL
Final Volume (ml)	**10**	**10**	**10**	**5**	**5**	**5**

*For Bis(2-chloroethyl)ether the 5.0 ppm level is prepared using the 100ppm standard.

Table 21
Reduced Volume Extraction/LVI – SIM
Working Standards Preparation

	0.005 PPM	**0.01 PPM**	**0.02 PPM**	**0.10 PPM**	**0.20 PPM**	**1.0 PPM**
0.025 PPM Std (see Table 20)	1.0 mL					
0.05 PPM Std (see Table 20)		1.0 mL				
0.1 PPM Std (see Table 20)			1.0 mL			
0.5 PPM Std (see Table 20)				1.0 mL		
1.0 PPM Std (see Table 20)					1.0 mL	
5.0 PPM Std (see Table 20)						1.0 mL
Final Volume (ml)	**5**	**5**	**5**	**5**	**5**	**5**

7.2.2.2 Initial Calibration Verification (SIM): A 0.1 ppm separate lot SIM ICV is prepared as detailed in Table 6 using the stock standards detailed in Section 7.2.1.4 (above)

Table 22
0.1ppm SIM ICV preparation

Pentachlorophenol	25uL
n-Nitrosodimethylamine	25uL
PAH mix	5uL
Hexachlorobenzene	5uL
1,4-Dioxane	5ul
4,6-Dinitro-2-methylphenol	100ul
ISTD	**100uL**
Final Volume	**5 ml**

7.2.2.3 **Internal Standard solution** (SIM): A 50 ppm Internal Standard solution for SIM analysis is prepared by adding 125ul of the 2000ppm stock ISTD (see Section 7.2.1.4) and bringing to volume with Methylene Chloride in a 5ml volumetric flask.

7.2.2.3.1 For SIM analysis inject 20ul of this solution (50ppm) per ml of sample extract prior to analysis resulting in a concentration of 1ppm (ug/ml) in the extract.

.

7.2.3. **Calibration Standards (Isotope Dilution SIM – 1,4-Dioxane):**The Edison lab currently analyzes only for 1,4-dioxane by 8270D isotope dilution SIM (see Sections 1.0 and 2.0). Stock analytical isotope dilution SIM standard solutions are purchased mainly from Accustandard and Restek. Working standards are prepared from these solutions as listed in the tables below.

Table 23 - Stock 1,4-Dioxane Isotope Dilution SIM Standards			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dioxane	1000ppm*	Accustandard	APP-9-096

* 1,4-Dioxane is diluted (10x) to 100ppm prior to SIM Standards prep

Table 24 - Stock Labeled 1,4-Dioxane SIM Surrogate/Internal Standard (added at prep)			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dioxane-d8	2000ppm	Restek	A0120108

Table 25 - Stock 1,4-Dioxane Isotope Dilution SIM Internal Standard (added to extract)			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dichlorobenzene-d4	2000ppm	Restek	A0121898

Table 26 - Stock 1,4-Dioxane Isotope Dilution SIM Separate Source ICV			
Standard Name	**Concentration**	**Vendor**	**Catalog #**
1,4-Dioxane	1000ppm	Absolute	70373

7.2.3.1 Individual calibration standards for 1,4-dioxane isotope dilution SIM analysis are prepared at the concentrations detailed in the following tables. Prepare by combining the appropriate volumes of each stock solution using volumetric flask. Dilute to the volume marker with methylene chloride.

Table 27
Reduced Volume Extraction/LVI – 1,4-Dioxane Isotope Dilution SIM
ICAL Standard Concentrations (ug/ml)

	Lev 1	Lev 2	Lev 3	Lev 4	Lev 4	Lev 6	ICV*
1,4-Dioxane	10	2	0.8	0.4	0.1	0.04	0.2
1,4-Dioxane-d8	4	4	4	4	4	4	4
1,4-Dichlorobenzene-d4	0.2	0.2	0.2	0.2	0.2	0.2	0.2

***:** The ICV is prepared from the second source stock in Table 26.

7.2.4. **GC/MS Instrument Performance Check (DFTPP):** The DFTPP standard is prepared by is prepared at 25 ppm by adding 2.5ml of EPA 8270 GC/MS Tuning Solution II (Supelco Catalog # 47548-U) to a 100ml volumetric flask and bringing to volume with Methylene Chloride.

7.2.5. Information on prepared standard solutions must be recorded in a standards logbook or in the TALS Reagent Module. Information such as standard supplier, lot number, original concentration, a description of how the standard was made, are required along with the laboratory lot number, analyst's initials, date prepared, expiration date and verification signature. Standards must be remade every 6 months, or sooner, if the standards expire or begin to show signs of unacceptable degradation. Class "A" volumetric must be used at all times and syringes, preferably gas-tight syringes when available, should be checked for accuracy using an analytical balance. Class "A" pipettes should also be used if volumes permit.

7.2.6. Please refer to TestAmerica Edison SOP No. ED-GEN-008, Standard Operating Procedure for Preparation, Purity and storage of Reagents and Standards.

- Shelf Life of Standard: 6 months
- Storage Requirements: Stock standards are stored at 4°C and Working Standards stored at -10°C to -20°C.

8.0 Sample Collection, Preservation, Shipment and Storage

8.1 All samples must be stored at 4ºC (± 2ºC) upon receipt.

8.2 Sample Extract Storage. Samples extracts must be protected from light and refrigerated at 4ºC (± 2ºC) from time of extraction until analysis.

8.3 Sample Extract Holding Time. All sample extracts must be analyzed within 40 days of extraction.

Matrix	Sample Container	Min. Sample Size	Preservation	Holding Time	Reference
Waters	Amber glass, 1L	1000 ml or 250 ml (1)	Cool 4 ± 2°C	7 days to extraction; Analyze within 40 days of extraction	EPA Method SW846 8270D
Solids	Wide mouth glass, 8 or 16 oz.	50g	Cool 4 ± 2°C	14 days to extraction; Analyze within 40 days of extraction	EPA Method SW846 8270D

(1) : Reduced volume extaction (RVE) LVI option

9.0 Quality Control

9.1. Sample QC - The following quality control samples are prepared with each batch of samples.

Quality Controls	Frequency	Control Limit
Method Blank (MB)	1 in 20 or fewer samples	< Rpt. Limit
Laboratory Control Sample (LCS)[1]	1 in 20 or fewer samples	Statistical Limits [4]
Matrix Spike (MS)[2]	1 in 20 or fewer samples	Statistical Limits [4]
MS Duplicate (MSD)[2]	1 in 20 or fewer samples	Statistical Limits [4]
Surrogates	every sample[3]	Statistical Limits [4]
Internal Standards	Every sample	Response within -50% to +100% of CCV

[1] LCS Duplicate (LCD) is performed only when insufficient sample is available for the MS/MSD or when requested by the client/project/contract.

[2] The sample selection for MS/MSD are randomly selected, unless specifically requested by a client….predetermined by the extraction lab.

[3] Analytical and QC samples (MB, LCS, MS/MSD, Method Blank)

[4] Statistical control limits are updated annually and are updated into lab reporting software.

9.1.1. **Method blanks** are extracted with every sample batch on each day that samples are extracted. To be considered acceptable, the method blank must contain less than the reporting limit of all target compounds except for phthalates, which can be present at up to 5x the MDL. .

If method blanks are unacceptably contaminated with target compounds that are also present in field samples, all affected samples must be re-extracted and re-analyzed. Corrective action must be taken to identify and eliminate the contamination source. Demonstrate that acceptable blanks can be obtained before continuing with sample extraction and analysis. Method blanks must be analyzed on each instrument on which the associated samples are analyzed.

9.1.1.1. Surrogate recoveries for the method blank are compared to laboratory generated limits. If two or more surrogates for any one fraction (base-neutral or acid) are outside of recovery limits or if any one surrogate recovers at <10%, the sample must be re-extracted and re-analyzed to confirm matrix interference.. If any surrogate is still outside limits, all samples and QC samples associated with that method blank must be re-extracted (volume permitting).

9.1.2. **Matrix Spike (MS)/Matrix Spike Duplicate (MSD):** A matrix spike/matrix spike duplicate (MS/MSD) pair is extracted and analyzed with every 20 environmental samples of a specific matrix (defined as a sample batch). Full compound list spiking is employed for MS/MSDs and LCSs. These spikes are prepared and extracted concurrent with sample preparation. MS and MSD recoveries are calculated and compared to lab generated acceptance criteria. See the current active TALS 8270D Method Limit Group for QC limits. The MS/MSD spiking solution should the same as used for the calibration standards.

9.1.2.1 A Laboratory Control Sample Duplicate (LCSD) is extracted and analyzed only when insufficient client sample is available for preparation of an MS/MSD pair. The LCS/LSCD is evaluated in the same manner as the MS/MSD (see Section 9.1.2)

9.1.2.2 An LCS/LCSD may be substituted for the MS/MSD if insufficient sample volume is available.

9.1.3. **Laboratory Control Sample (LCS)/Laboratory Control Sample Duplicate (LCSD):** A Laboratory Control Sample (LCS) (aka blank spike) must be extracted and analyzed with each batch of 20 environmental samples. The LCS data is used to assess method performance if the MS/MSD recoveries fall outside of the lab generated limits (See the current active TALS 8270D Method Limit Group for QC limits). If the LCS recovery is within the current lab generated limits, the MS/MSD recoveries are attributed to matrix interference.

9.1.3.1 A Laboratory Control Sample Duplicate (LCSD) is extracted and analyzed only when insufficient client sample is available for preparation of an MS/MSD pair. The LCS/LSCD is evaluated in the same manner as the MS/MSD (see Section 9.1.2)

9.1.3.2 Spike recovery limits are lab generated and are updated annually. Certain state regulatory programs have defined recovery limits which, where applicable, are used for spike recovery evaluations. The TALS Method Limit Groups detail these regulatory program criteria.

9.1.4. **Surrogate Standards:** All full scan samples, blanks and QC samples are spiked with a six (6) component surrogate standard mix (see Section 7.2.1.3). The percent recovery of the surrogate standards is calculated and compared to lab generated limits (See the current active TALS 8270D Method Limit Group for QC limits). **Note:** Three (3) surrogates are used when analyzing for Aromatic Amines (see Section 7.2.1.3.1).

If any two or more surrogates for any one fraction (base-neutral or acid) are outside of recovery limits or if any one surrogate recovers at <10%, the sample must be re-extracted and re-analyzed to confirm matrix interference. If a surrogate is diluted to a concentration below that of the lowest calibration standard, no corrective action is necessary.

9.1.4.1 Surrogate recovery limits are lab generated and are updated annually. Certain state regulatory programs have defined recovery limits which, where applicable, are used for spike recovery evaluations. The TALS Method Limit Groups detail these regulatory program criteria.

9.1.5. **Internal Standards:** The response (area count) of each internal standard in the sample must be within -50 +100% of its corresponding internal standard in the CCV or, the ICAL midpoint for samples analyzed under the initial calibration range. Failure to meet these criteria is indicative of sample matrix effects. All samples failing these criteria must be reanalyzed to confirm matrix effects.

9.2. Instrument QC

9.2.1 **GC/MS Instrument Performance Check (DFTPP)**: (**Note**: the DFTPP performance check applies only to full scan analyses and is not evaluated for SIM analysis). The GC/MS system is tuned using Perfluortributylamine (PFTBA) such that an injection of 50ng of Decafluorotriphenylphosphine (DFTPP) meet the abundance criteria listed in the table below. Prior to the analysis of any calibration standards or samples, the GC/MS system must meet all DFTPP key ion abundance criteria. This analysis will verify proper tuning of the system for a period of 12 hours post-injection. After 12 hours, the instrument performance must again be verified prior to the analysis of standards, QC or samples.

DFTPP Key Ions and Abundance Criteria

Mass	**Ion Abundance Criteria**
51	30-60% of mass 198
68	<2% of mass 69
69	reference only
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base Peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198

DFTPP Key Ions and Abundance Criteria	
365	>1% of mass 198
441	present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

9.2.1.1. Evaluate DFTPP using three scan averaging and background subtraction techniques. Select the scan at the peak apex, add +1 scan from the apex and -1 scans from the apex.

9.2.1.2. The mass spectrum of DFTPP may be background subtracted to eliminate column bleed or instrument background ions. Background subtract DFTPP by selecting a scan for subtraction ≤20 scans <u>before</u> the apex scan of DFTPP.

9.2.1.3. Check column performance using pentachlorophenol and the benzidine peaks (these compounds are included in the DFTPP solution). Benzidine & Pentachlorophenol should respond normally without significant peak tailing (Tailing Factor should be <2 measured at 10% peak height). If responses are poor and excessive peak tailing is present, corrective action for the GC/MS instrument may be required. Corrective actions may include:

9.2.1.3.1 Retune the GC/MS;
9.2.1.3.2 Clip the injector end of the GC column;
9.2.1.3.3 Replace the septum and injection port liner;
9.2.1.3.4 Change the injection port seal;
9.2.1.3.5 Replace the GC column;
9.2.1.3.6 Clean the injection port with MeCl2
9.2.1.3.7 Clean the MS ion source;
9.2.1.3.8 Place a service call.

9.2.1.4. The breakdown of 4, 4-DDT into 4,4-DDD and 4,4’DDE may also be used to assess GC column performance and injection port inertness. If so evaluated the breakdown must be <20%.

9.2.1.5. DFTPP parameter settings are stored in a tune file, which will be used in all subsequent analysis of standards and sample extracts.

9.2.2 Initial Calibration Range and Initial Calibration Verification

9.2.2.1. **Initial Calibration:** The initial calibration range consists of a minimum of five concentration levels of analytical standards (six for second order regression) prepared as described in Section

7.2. and analyzed once the DFTPP instrument performance check has met the criteria in Section 9.2.1. .

9.2.2.2. **Initial Calibration Verification (ICV):** An Initial Calibration Verification (ICV) standard is analyzed immediately after the Initial Calibration Range and before any samples are analyzed. The ICV is prepared as detailed in Section 7.2. The ICV must be from a source (or lot) separate from the standards used in the Initial Calibration Range.

9.2.3 **Continuing Calibration Verification (CCV) and Low Level Continuing Calibration Verification (LLCCV):** A mid-point Continuing Calibration Verification (CCV) must be analyzed every 12 hours after the DFTPP instrument performance check (when applicable).. The CCV is prepared as detailed in Section 7.2. (typically, 50 ug/ml for full volume aqueous and soils, 10 ug/ml for LV, 0.02 ug/ml for LVI SIM) and 0.2 for isotope dilution SIM). Additionally a Low Level Continuing Calibration Verification (LLCCV) is analyzed after the CCV for full scan analysis. The LLCCV is the same as the lowest calibration level analyzed with the initial calibration range (See Section 7.2).

9.2.4 Calibration Acceptance Summary

9.2.4.1. **Retention Time Windows:** Retention time windows must be established to compensate for minor shifts in absolute retention times as a result of sample loading and normal chromatographic variability. Obtain the retention time for all compounds from the analysis of the midpoint standard for the calibration curve. Establish the center of the retention time window by using the absolute retention time for each analyte, internal standard and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration. For qualitative identification to be acceptable the retention time of the relative retention time (automatically calculated in Chrom) must be within 0.8 - 1.2 RRT units of its assigned internal standard. The relative retention times of each compound in the five calibration standards must agree within .06 relative retention time units.

9.2.4.2. **Initial Calibration Range:** Internal standard calibration is employed for this method. After the initial calibration range has been analyzed the relative response factor (RRF) for each target/surrogate compound at each concentration level is determined using the following equation.

$$RRF = \frac{A_x}{A_{is}} x \frac{C_{is}}{C_x}$$

Where:
A_x = Area characteristic ion (see Table 31) for the compound
Ais = Area characteristic ion (see Table 31) of associated internal standard
Cis = Concentration of internal standard
Cx = Concentration of compound in standard

9.2.4.2.1. Determine the mean RRF for each compound. Minimum response factors must be met for each of the compounds listed in Table 28 (below). Any compound that fails the minimum response factor must be reported as estimated for detects and must have a demonstration of sensitivity in the analytical batch to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only but the standard qualitative identification criteria in the method must be met.

Table 28:
Minimum Response Factors

Compound	Minimum Response Factor
Benzaldehyde	0.010
Phenol	0.800
Bis(2-chloroethyl) ether	0.700
2-Chlorophenol	0.800
2-Methylphenol	0.700
2,2-Oxybis-(1-chloropropane)	0.010
Acetophenone	0.010
4-Methylphenol	0.600
N-Nitroso-di-n-propylamine	0.500
Hexachloroethane	0.300
Nitrobenzene	0.200
Isophorone	0.400
2-Nitrophenol	0.100
2,4-Dimethylphenol	0.200
Bis(2-chloroethoxy)methane	0.300
2,4-Dichlorophenol	0.200
Naphthalene	0.700
4-Chloroaniline	0.010
Hexachlorobutadiene	0.010
Caprolactam	0.010
4-chloro-3-methylphenol	0.200
2-Methylnaphthalene	0.400
Hexachlorocyclopentadiene	0.050
2,4,6-Trichlorophenol	0.200
2,4,5-Trichlorophenol	0.200

Table 28: Minimum Response Factors	
Compound	**Minimum Response Factor**
1,1’-Biphenyl	0.010
2-Chloronaphthalene	0.800
2-Nitroaniline	0.010
Dimethyl phthalene	0.010
2,6-Dinitrotoluene	0.200
Acenaphthylene	0.900
3-Nitroaniline	0.010
Acenaphthene	0.900
2,4-Dinitrophenol	0.010
4-Nitrophenol	0.010
Dibenzofuran	0.800
2,4-Dinitrotoluene	0.200
Diethyl phthalate	0.010
1,2,4,5-Tetrachlorobenzene	0.010
4-chlorophenyl-phenyl ether	0.400
Fluorene	0.900
4-Nitroanailine	0.010
4,6-Dinitro-2-methylphenol	0.010
4-Bromophenyl-phenyl ether	0.100
N-Nitrosodiphenylamine	0.010
Hexachlorobenzene	0.100
Atrazine	0.010
Pentachlorophenol	0.050
Phenanthrene	0.700
Anthracene	0.700
Carbazole	0.010
Di-n-butyl phthalene	0.010
Fluoranthene	0.600
Pyrene	0.600
Butyl benzyl phthalate	0.010
3,3’-Dichlorobenzidine	0.010
Benzo(a)anthracene	0.800
Chrysene	0.700
Bis-(2-ethylhexyl)phthalate	0.010
Di-n-octyl phthalate	0.010
Benzo(b)fluoranthene	0.700
Benzo(k)fluoranthene	0.700
Benzo(a)pyrene	0.700
Indeno(1,2,3-cd)pyrene	0.500
Dibenz(a,h)anthracene	0.400
Benzo(g,h,i)perylene	0.500
2,3,4,6-Tetrachlorophenol	0.010
Pentachloronitrobenzene	0.050

9.2.4.2.2. Calculate the Standard Deviation (SD) and Percent Relative Standard Deviation (% RSD) of the response factors for each compound:

$$\% \text{ RSD} = \frac{\text{Standard Deviation of RRFs}}{\text{Mean RRF}}$$

9.2.4.2.3. The % RSD of the RRF's must be ≤20% for each target analyte listed in Table 28. The % RSD of each target analytes must be ≤20% in order for the calibration range to be acceptable. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit or do not meet the minimum correlation coefficient (0.99) for alternate fits (see below) then appropriate corrective maintenance action must be performed. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit **AND** do not meet the minimum correlation coefficient (0.99) then recalibration is necessary.

9.2.4.2.4. If the above listed criteria is met, the system can be assumed to be linear and sample analysis may begin and the average RF from the initial calibration range is used to quantitate all samples.

9.2.4.2.4.1 Certain state regulatory programs have defined calibration acceptance limits which, where applicable, are used for calibration evaluations. The TALS ICAL Limit Groups detail these regulatory program criteria.

9.2.4.2.5. An alternative calibration technique may be employed for those any compounds exceeding the 20% RSD criteria:

9.2.4.2.5.1 Calculate the first order linear regression for any compound which did not meet the 20% criteria. First order linear regression calibration may be employed if alternative average response calibration procedures were not applicable. The r value (Correlation Coefficient) of the equation must be ≥0.99 for the calibration to be employed.

9.2.4.2.5.2 Second order regression calibration can be used for any compound that has an established history as a non-linear performer.

9.2.4.2.5.3 If second order regression calibration is used a minimum of six (6) calibration levels must be analyzed.

9.2.4.2.5.4 If second order regression calibration is used, the r^2 (Correlation Coefficient) value must be $\geq$ 0.99

9.2.4.2.5.5 Any compound that fails to meet the 20% RSD or or 0.99 correlation coefficient criteria must be flagged as estimated for detects (or must be noted in the narrative). If there are non-detects the compounds may be reported if there is adequate sensitivity to detect at the quantitation limit. To demonstrate adequate sensitivity analyze the low level point of the initial calibration in each analytical batch (LLCCV) The criteria for demonstrating adequate sensitivity is detection in the LLCCV using the standard qualitative identification criteria.

9.2.4.2.5.6. When calculating the calibration curve using the linear calibration model a minimum quantitation check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration back into the curve. The recalculated concentration of the low calibration point should be within ±30% of the standard's concentration. This evaluation can be checked using the Initial Calibration %Drift Report in Chrom. Any detects for analytes calibrated using the linear model and failing this readback criterion must be flagged as estimated or detailed in the narrative.

9.2.4.3. **Initial Calibration Verification (ICV):**.Once the initial calibration has been analyzed and has met the above criteria, a second source Initial Calibration Verification (ICV) (as prepared in Section 7.2) must be analyzed and evaluated. The ICV must meet the criteria of 70-130% recovery for all compounds with the exception of the poor performing compounds listed in Attachment 1 which are allowed to be within 50-150% : An NCM must be initiated to denote any ICV non-conformances.

9.2.4.4. The ICV must meet the criteria of 70-130% recovery for all compounds however up to 10% of the compounds are allowed to exceed these criteria as long as their recoveries are within 65-135%. For the poor performers (see Attachment 1) the range is 50-150%. If the criterion is not met, a second ICV may be analyzed after corrective measures are taken. If a second ICV analysis fails to meet criteria proceed with corrective action and the analysis of a new initial calibration range. Flagging: If the ICV limits are outside of criteria (high) for an analyte and that analyte is undetected in the sample, no flagging or narration is required. If the ICV limits are outside of criteria (low) for an analyte and that analyte is undetected in a sample, narrate the non-conformance in an NCM. When that out of spec analyte is detected in a sample, describe the issue in the narrative, or flag as estimated.

9.2.4.5. **Continuing Calibration Verification (CCV):** A CCV consisting of a standard at or near the midpoint of the Initial Calibration Range is analyzed every 12 hours of instrument operation or at the beginning of an analytical sequence to verify the initial calibration. The calibration verification consists of a DFTPP instrument performance check, and analysis of a calibration verification standard. **Note:** Certain state regulatory programs have defined calibration acceptance limits which, where applicable, are used for calibration evaluations. The TALS ICAL Limit Groups detail these regulatory program criteria.

9.2.4.5.1 Tune Verification: Follow the procedure for verifying the instrument tune described in section 9.2.1 using a 50 ng injection of DFTPP. If the tune cannot be verified, analysis must be stopped, corrective action taken and a return to “control” demonstrated before continuing with the calibration verification process.

9.2.4.5.2 Calibration Verification: Analyze the calibration verification standard immediately after a DFTPP that meets criteria. Use the mid point calibration standard (approximately 50ug/l). <u>NOTE</u>: The calibration standard contains internal standards; Dichlorobenzene d_4, Naphthalene d_8, Acenaphthene d_{10}, Phenanthrene d_{10}, Chrysene d_{12}, and Perylene d_{12} at 40ug/l (0.1ug/L for SIM). The calibration check standard must also include all the target analytes from the original calibration.

9.2.4.5.3 The RFs must meet the criteria for the compounds in Table 28. Any compound that fails the minimum response factor must be reported as estimated for detects and must have a demonstration of sensitivity to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only but the standard qualitative identification criteria in the method must be met

9.2.4.5.4 The percent difference (when using average response factor) or percent drift (when using linear regression) of the compounds in Table 28 must be ≤20% for at least 80% of the total analyte list. If more than 20% of the compound list fail to 20% difference or drift criterion then appropriate corrective action must be taken prior to the analysis of the samples. Any individual compound that fails must be reported as estimated for detects and must have a demonstration of sensitivity to report non-detects. To demonstrate adequate sensitivity for out of criterion compounds analyze the low level point of the calibration (LLCCV) in the analytical sequence. The criterion for the LLCCV is detection only (%D criteria are not applied) but the standard qualitative identification criteria in the method must be met.

9.2.4.5.5 **CCV Poor Performers**: Refer to Attachment 1 for the identification of poor and/or erratic performing analytes. These analytes are allowed a %D >20% but must be <50 %D to be acceptable. If there are poor performers that exceed 50%D, the data may be reported provided results are noted as estimated. An NCM must be initiated to denote this situation.

9.2.4.5.6 The retention times of the internal standards from the calibration check must be within ±30 seconds of the internal standards from the mid point standard of the original calibration. If the retention time for any internal standard changes by more than 30 seconds from the latest daily (12 hour) calibration standard, the chromatographic system is inspected for malfunctions, and corrections made as required. If corrective action does not result in the retention time criteria being achieved, the system must be re-calibrated using four additional standards.

9.2.4.5.7 The response (area count) of each internal standard in the calibration verification standard must be within 50 - 100% of its corresponding internal standard in the mid-level calibration standard of the active calibration curve. If the EICP area for any internal standard changes by more than a factor of two (-50% +100%), the mass spectrometer system must be inspected for malfunction and corrections made as appropriate. When corrections are made, re-analysis of samples analyzed while the system was malfunctioning is required.

9.2.4.5.8 The relative retention times of each compound in the calibration verification standard must agree within .06 relative retention time units of its value in the initial calibration.

9.2.4.5.9 Use the average response factors from the original five-point calibration for quantitative analysis of target analytes identified in field samples.

9.2.4.5.10 Prepare a calibration summary or list indicating which compounds did not meet the 20% average percent difference criteria. Record this information in that run log.

9.2.4.6. **Low Level Continuing Calibration Verification (LLCCV):** An LLCCV consisting of the low level standard from the initial calibration range is analyzed every 12 hours of instrument operation after the CCV. The purpose and evaluation of the LLCCV is described in Section 9.2.4.4.4.

10.0 Procedure

10.1. Gas Chromatograph/Mass Spectrometer Operation

10.1.1. The sequence of events for GC/MS analysis involves many steps. First the injection system and column performance and calibration must be verified. Maintenance operations are performed as needed.

10.1.2. **Preparation of the Injection Port Liner and Installation Procedure**: Prior to the start of initial calibration and each daily analysis of sample extracts, a new liner for the injection port must be prepared. Once a liner has been used it is no longer inert and will cause serious chromatography problems with phenols and other compounds. When preparing the liner, proper laboratory protection must be worn and the liner must be prepared in a well-ventilated hood. When the procedure is completed all traces of toluene, Sylon-Ct and methanol will be removed immediately so that extraction solvents and preparation of sample extracts will not come into contact with these solvents and become contaminated.

10.1.2.1 Remove one liner from a 40ml VOA bottle containing other liners immersed in Sylon-Ct solution. Rinse off the liner with Toluene and wipe dry. Insert 1cm of pre-silanized glass wool partially into one end of the liner and trim neatly. Push the glass wool into the center of the liner so that it is 1 1/4" from the bottom. Do not use glass wool or solvents that are dirty (i.e. suspended particles) or use liners which are chipped on the ends, deformed or fractured. Inspect the glass wool for cleanliness after it has been inserted.

10.1.2.2 Using a Pasteur pipette flush out the interior of the liner containing the glass wool with Sylon-Ct. Rest the liner horizontally on a small beaker and allow the Sylon-Ct to re-deactivate the interior surfaces and the glass wool. There should be no air bubbles caught in the glass wool. After several minutes flush out the Sylon-Ct with toluene and finally with methanol. Dry the outer surface of the liner and rest it on the injection port housing until the remaining methanol is boiled off

10.1.2.3 Insert the liner with the newly silanized glass wool plug into the injection port. Verify that the column extends up into the injection port and is perpendicular. Inspect the graphite seal and replace it if the edges are knife-shaped.

10.1.2.4 The septum is always replaced daily. Bake out the column at 300°C for 15 minutes after the vacuum in the analyzer has returned to normal.

10.1.2.5 Performance may enhanced by clipping a small portion of the column at the injection port end. Document this activity in the maintenance record.

10.1.3. Prior to calibration or sample analysis always verify that the analyzer is under sufficient vacuum and that the column has proper carrier gas flow.

10.1.4. Establish the following GC/MS operating conditions:

10.1.4.1 Full Scan Operating Mode

Full Scan Mode – Standard Injection Volume
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.0 minutes
Initial Column Temperature and Hold Time: 45°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 5 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse, splitless
Injection Volume: 1ul
Splitless Valve Time: 0.3 minutes

Full Scan Mode – Large Volume Injection (LVI)
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.0 minutes
Initial Column Temperature and Hold Time: 45°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 5 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse, splitless
Injection Volume: 5ul
Splitless Valve Time: 0.3 minutes

10.1.4.2 SIM Operating Mode

SIM Mode
Mass Range: 35 to 500amu
Scan Time: 1 sec/scan
Transfer Line Temperature: 300°C
Source Temperature: Preset by H.P. at 280°C
Scan start time: 1.5 minutes
Initial Column Temperature and Hold Time: 40°C for 0.5 minutes
Column Temperature Program: 20°C /min to 100°C 25°C/min to 270°C 10° C/min to 310°C
Final Column Temperature Hold: 310°C for 3 minutes
Carrier Gas: Ultra High Purity Grade Helium at 1.3ml/min
Injector Temperature: 275°C
Injector: Grob-type, pulse splitless
Injection Volume: 1ul
Splitless Valve Time: 0.3 minutes

10.1.4.3 Isotope Dilution Selected Ion Monitoring Mode :

SIM Parameters

Group 1
Plot 1 Ion: 74.0
Ions/Dwell in Group

(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
42.0	50	43. 0	50	68.0	50
74.0	50	128.0	50	129.0	50
136.0	50	150.0	50	152.0	50
93.0	50	66.0	50		
58.0	50				
88.0	50				

Group 2
Group Start Time: 6.00
Plot 1 Ion: 152.0
Ions/Dwell in Group

(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
151.0	50	152.0	50	153.0	50
154.0	50	162.0	50	164.0	50
165.0	50	166.0	50		

Group 3
Group Start Time: 7.80
Plot 1 Ion: 188.0
Ions/Dwell in Group

(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
94.0	50	101.0	50	142.0	50
178.0	50	179.0	50	188.0	50
202.0	50	264.0	50	266.0	50
284.0	50				

Group 4
Group Start Time: 10.50
Plot 1 Ion: 228
Ions/Dwell in Group

(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
120.0	50	228.0	50	229.0	50
240.0	50				

Group 5
Group Start Time: 12.00
Plot 1 Ion: 252.0

Ions/Dwell in Group

(Mass	Dwell)	(Mass	Dwell)	(Mass	Dwell)
138.0	50	139.0	50	252.0	50
253.0	50	260.0	50	264.0	50
267.0	50	276.0	50	278.0	50

Table 29: Target Compound - Primary and Monitoring Ions

Compound	1	2	3
1,4-Dioxane-d8	96	64	62
1,4-Dioxane	88	58	57
1,4-Dichlorobenzene-d4	152	150	

10.1.5. The above listed instrument conditions are used for all analytical standards for calibration and for all sample extracts analyzed by this method.

10.1.5.1 The column conditions, scan start time, and splitless valve time for analysis of DFTPP only are as follows are as follows:

Initial Column Temperature and Hold Time: 140°C for 0.5 minutes
Column Temperature Program: 140° to 320°C at 22°C/minute
Final Column Temperature Hold: 320C for 0.5 minutes
Scan Start Time: approx. 5 minutes
Splitless Valve Time: 0.3 minutes
Injection Volume: 2 ul

10.2. Analytical Sequence

10.2.1. Screening: All samples extracts must be screened by GC/FID using the identical chromatographic conditions described in section 9.2. Screening is used to determine the dilution factor of the sample (if any) prior to GC/MS analysis (for additional details see TestAmerica Edison SOP No. ED-GCS-001, *Preparation and Screening of Semivolatile Organic Extracts for GC/MS Analysis*, current revision).

10.2.1.1. Aqueous samples: Prior to extract screening, the extract is diluted to 2ml and split into two 1-ml aliquots:

- One 1-ml aliquot is internal standardized with 20ul of the 2000 ng/ul internal standard solution for full scan analysis and is analyzed by GC/FID for screening.
- The other aliquot is archived for SIM analysis which is internal standardized with 20ul of 50ppm SIM Internal Standard

10.2.1.2. Soil samples: Final volume is 1ml and extracts are internal standardized with 20ul of the 2000 ng/ul internal standard solution and analyzed by GC/FID for screening.

10.2.1.3. After screening analysis, the chromatogram is evaluated for high concentrations of organics. Determine dilutions by comparing the peak heights of compounds in the sample with the internal standard. The ratio of naturally present compounds to internal standards must be <5:1.

10.2.1.4. Dilutions are made based on the screening analysis and prior to GC/MS analysis. Dilutions are made in 1-ml vials using microsyringes. Calculate the dilution factor using the equation below:

DF= Ph / 5 x Is

Where:
DF = Dilution Factor
Ph = Sample Peak Height
Is = Internal Standard Peak Height

When DF >1 but <2, combine 500ul of sample extract with 500ul methylene chloride in a 1 ml amber vial, add20 ul internal standard and crimp seal

Use **Table 30** to determine dilution and internal standard amount.

Table 30
Dilution Factor Calculations

DF Value	Volume of Sample (ul)	Volume of Methylene Chloride (ul)	Volume of ISTD (ul)
<1	1,000	None	None
>1, <2	500	500	10
>4, <5	200	800	16
>10, <20	100	900	36
>20	500*	500	10

*Prepare this dilution by serially diluting the >10, <20 dilution

10.2.2. Instrument Performance and Calibration Sequence

10.2.2.1. Once the GC/MS instrument has been setup and maintained as detailed in Section 10.1, the first operations to be performed are the performance checks and calibration standards.

10.2.2.2. Analyze the Instrument Performance Check Standard (DFTPP) as discussed in Section 9.2.1.

10.2.2.3. Initially and as required, analyze the Initial Calibration Range (minimum 5 points, six points for second order regression) as detailed in Sections 7.2.1 and 9.2.4.2. Evaluate the acceptability of the Initial Calibration Range as detailed in Section 9.2.4.2.

10.2.2.4. Immediately after the Initial Calibration Range only, analyze the Initial Calibration Verification (ICV) as detailed in Sections 7.2. and 9.2.4.3. Evaluate the acceptability of the ICV as detailed in Section 9.2.4.3.

10.2.2.5. Every 12 hours, reanalyze and evaluate the Instrument Performance Check Standard (DFTPP) followed by the Continuing Calibration Verification (CCV) and Low Level Continuing Calibration Verification (LLCCV) as detailed in Section 9.2.3, 9.2.4.4 and 9.2.4.5. Evaluate the acceptability of the CCV and LLCCV as detailed in Section 9.2.4.4

10.2.2.6. Client samples and QC samples are analyzed (as detailed in Section 10.2.3) after acceptable Instrument Performance and Calibration Checks and until the 12 hour clock expires. Repeat the sequence as required. The automation of GC/MS runs is accomplished via the “SEQUENCE” macro of the ChemStation.

10.2.3. Sample Analysis Sequence

10.2.3.1. Sample extracts are normally prepared on the same day as analysis. The GC/MS operator will prepare the extracts that will be run on his or her instrument. Volume adjustments to the extracts will be made at the discretion of the supervisor.

10.2.3.2. Prior to the start of sample analysis the GC/MS operator will generate a sequence program containing the list of the sample extracts to be analyzed, the position on the autosampler tray, and the proper acquisition and tune methods that are to be used. This sequence program contains all the necessary information on the samples to be analyzed and how the GC/MS system is to analyze them. The sample extracts are loaded onto the autosampler (ALS) tray. Their position is verified by checking them against the ALS number on the sequence. This batch analysis will be performed automatically over the 12-hour period.

10.2.3.3. The analytical run log is printed as a record of samples analyzed. The analyst will annotate the run log with any required information regarding anomalies or unusual events. The run log must be signed by the analyst and a reviewed and signed by a trained peer or manager

10.3. Data Processing

10.3.1. Prior to processing any standards or samples, target compound lists and sublists must be assembled. Chrom's auto-processing system queries TALS (LIMS) for each sample's processing parameters (including target compounds lists) and downloads the required processing methods from LIMS to analyze data. These lists are required for processing of all data files including calibration files. The data includes compound names, retention time data, quantitation ions, qualitative identification ions, and the assigned internal standard for qualitative and quantitative identification.

10.3.2. Key data is manually entered the first time a compound list is used for data processing. Processing data using a compound list automatically generates response factor data and updates retention information.

10.3.3. The characteristic ions for target compounds, surrogate compounds, and internal standards which can be determined using SW8270D are listed in Table 31.

10.4. Interpretation and Qualitative Identification: Qualitative identification of target compounds is based on retention time and mass spectral comparison with characteristic ions in the target compound list. The reference mass spectrum is taken from a standard of the target compound analyzed by this method. The characteristic ions are the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met:

10.4.1 Target Analytes: Qualitative identification of target compounds is based on retention time and mass spectral comparison with characteristic ions in the target compound list. The reference mass spectrum is taken from a standard of the target compound analyzed by this method. The characteristic ions are the three ions of greatest relative intensity or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum. Compounds are identified as present when the following criteria are met:

10.4.1.1. Once the GC/MS instrument has been setup and maintained as detailed in Section 10.1, the first operations to be performed are the performance checks and calibration standards.

10.4.1.2. The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other.

10.4.1.3. The relative retention time (RRT) of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

10.4.1.4. The most abundant ion in the standard target spectrum that equals 100% MUST also be present in the sample target spectrum.

10.4.1.5. All other ions that are greater than 10% in the standard target spectra should also be present in the sample.

10.4.1.6. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%).

10.4.1.7. If the compound does not meet all of the criteria listed above, but is deemed a match in the technical judgment of the mass spectral interpretation specialist, the compound will be positively identified and reported with documentation of the identification noted in the raw data record.

10.4.2 **Non-Target Analytes:** Upon client request a library search to identify non-target Tentatively Identified Compounds (TIC) is performed. The NIST/EPA/NIH mass spectral library is used to identify non-target compounds (not including internal standard and surrogate compounds) of greatest apparent concentration by a forward search of the library. The following guidelines are used by the analyst when making TIC identifications:

10.4.2.1. Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.

10.4.2.2. The relative intensities of the major ions should agree within ±20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%).

10.4.2.3. Molecular ions present in the reference spectrum should be present in the sample spectrum.

10.4.2.4. Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting compounds.

10.4.2.5. Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting peaks. Data system library reduction programs can sometimes create these discrepancies.

10.4.2.6. If, in the technical judgement of the mass spectral interpretation specialist, no tentative identification can be made, the compound will be reported as ‘Unknown’. If the compound can be further classified the analyst may do so (i.e, ‘Unknown hydrocarbon’, ‘Unknown acid’ , etc.).

10.5. Data Reporting

10.5.1. Final Report. The Chom data system automatically produces a data report consisting of hardcopy reports corresponding to specific data reporting requirements, which is uploaded to the TALS LIMS System for the report production group.

10.5.1.1. Total Ion Chromatogram. Full length chromatogram depicting the full length of the GC/MS acquisition.

10.5.1.2. Spectra of all detected target compounds. A page for each detected target compound spectra with a standard reference spectrum for comparison.

10.5.1.3. The calculations of the concentrations of each target compound in the sample, reported in units of ppb, ug/kg or ug/l.

10.5.1.4. Data summaries for each method blank indicating which samples were extracted with the indicated blank.

10.5.1.5. A copy of the initial calibration range together with the calibration verification report, and tune report.

10.5.1.6. Quality Control (QC) data report for each batch including surrogate recoveries, internal standard area summaries, LCS, MS/MSD and RPD summaries.

10.6. The low-level calibration standard establishes the reporting limit. All reported data must be at a concentration at or above the low concentration standard. Any quantitative values below the report limit must be qualified as estimated.

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11.0. Calculations/Data Reduction

11.1. **Target Compounds:** are quantitated using the internal standard method (see the formula in Section 11.3).

11.1.1. Identified target compounds are quantitated using the integrated abundance from the EICP of the primary characteristic ion. The internal standard used shall be the one nearest the retention time of the analyte).

11.1.2. The average response factor (RRF) from the initial calibration is used to calculate the target analyte concentration in client samples using the formula found in Section 11.3. See Section 9.2.4 for discussion of RRF.

11.1.3. Secondary ion quantitation is utilized only when there are sample interferences preventing use of the primary characteristic ion. If secondary ion quantitation is used an average relative response factor (RRF) must be calculated using that secondary ion.

11.2. **Non-Target Compounds (Tentatively Identified Compounds):** An estimated concentration for non-target (tentatively identified compounds) is calculated using the internal standard method (see formula in Section 11.3). For quantiation, the nearest eluting internal standard free of interferences is used. The procedure used for calculating the concentration of non-target compounds is the same as that used for target compounds (see Section 11.1) with the following revisions:

11.2.1. The total area count of the non-target compound is used for As (instead of the area of a characteristic ion).

11.2.2. The total area count of the chosen internal standard is used as Ais (instead of the area of a characteristic ion).

11.2.3. A RF on 1.0 is assumed.

11.2.4. The resulting concentration is qualified as estimated (‘J’) indicating the quantitative uncertainties of the reported concentration.

11.3. Internal Standard Calculation:

11.3.1. Aqueous Samples

$$\text{Concentration } (\mu g/L) = \frac{(As)(Cis)(D)}{(Ais)(RF)(Vs)\,(Vi)\,(1000)}$$

Where:

As = Area of the characteristic ion for the target analyte in the sample
Cis = Concentration of the internal standard (ug/L)
D = Dilution factor, if the sample or extract was diluted prior to analysis. If no dilution is performed, D = 1.
Vi = Volume of the extract injected (ul)
Ais = Area of the characteristic for the associated internal standard
RF = Average response factor from the initial calibration.
Vs = Volume of sample extracted (ml)

The 1000 in the denominator represents the number of ul in 1 ml.

11.3.2. Solid Samples

$$\text{Concentration } (\mu g/KG) = \frac{(As)(Cis)(D)(Vt)}{(Ais)(RF)(Ws)\ (Vi)\ (1000)}$$

Where:

As = Area of the characteristic ion for the target analyte in the sample
Cis = Concentration of the internal standard (ug/L)
D = Dilution factor, if the sample or extract was diluted prior to analysis. If no dilution is performed, D = 1.
Vi = Volume of the extract injected (ul)
Ais = Area of the characteristic for the associated internal standard
RF = Average response factor from the initial calibration.
Vt = Volume of concentrated extract (ul)
Ws = Weight of sample (g)

The 1000 in the denominator represents the number of ul in 1 ml.

11.4. Relative Response Factors

$$RRF = \frac{A_x}{A_{is}} \times \frac{C_{is}}{C_x}$$

Where:

A_x = Area characteristic ion for the compound (see Table 31)
Ais = Area characteristic ion of associated internal std (See Table 31)
Cis = Concentration of internal standard
Cx = Concentration of compound in standard

11.5. Percent Relative Standard Deviation (% RSD) : as discussed in Section 9.2.4.4 (Initial calibration):

$$\% RSD = \frac{\text{Standard Deviation of RRFs}}{\text{Mean RRF}}$$

11.6. Percent Difference (% D):as discussed in Section 9.2.4.4 (Continuing calibration):

$$\% D = \frac{RRF_c - \overline{RRF_i}}{\overline{RRF_i}} \text{ X } 100$$

Where: RRFc = RRF from continuing calibration

$\overline{RRF_i}$ = Mean RRF from current initial calibration

11.7. Percent Recovery (% R): Surrogates and Spikes

$$\text{Recovery (\%)} = \frac{\text{Concentration (or amount) found}}{\text{Concentration (or amount) added}} \times 100$$

11.8. Dry Weight Correction: All solid samples must be corrected for dry weight using the following formula for dry weight determination.

$$DW = \frac{Gd}{Gw} \times 100$$

Where:

DW	=	Percent % Dry Weight
Gd	=	Dry weight of selected sample aliquot
Gw	=	Wet weight of selected sample aliquot

Multiply the DW value times the wet weight of the sample extracted. NOTE: This calculation can also be performed automatically by the target system provided the DW value is available and entered into the system.

12.0. Method Performance

12.1. Method Detection Limit Study (MDL)

The method detection limit (MDL) is the lowest concentration that can be detected for a given analytical method and sample matrix with 99% confidence that the analyte is present. The MDL is determined according to the laboratory's MDL procedure in Section 19 (Test Methods and Method Validation) of TestAmerica Edison's Quality Assurance Manual (ED-QA-LQM). MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method requirements require a greater frequency.

12.2. Demonstration of Capabilities

For DOC procedure refer to Section 19 in the most current revision of TestAmerica Edison's Quality Assurance Manual (ED-QA-LQM).

12.3. Training Requirements

Refer to TestAmerica SOP No. ED-GEN-022, (*Training*), for the laboratory's training program.

13.0. Pollution Control

13.1 It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Environmental Health and Safety Manual (CW-E-M-001) for "Waste Management and Pollution Prevention."

14.0. Waste Management

14.1 Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to TestAmerica Edison SOPs Nos. ED-SPM-007 (*Disposal of Samples and Associated Laboratory Waste, current revision)* and ED-SPM-008 (*Laboratory Waste Disposal Procedures, current revision).* The following waste streams are produced when this method is carried out:

- Auto sampler vials and expired standards: These vials are collected in satellite accumulation within the instrument laboratory. The vials are then placed into a 55 steel open top drum in the waste room. When the drums are full, the drum will be collected by the waste vendor for disposal. This waste is treated for incineration.

  Teris Profile Number: 50016652
  Onyx Profile WIP Number: 282493

- Mixed Solvent Waste: Mixed solvent waste is collected in a small beaker inside the bench top hood. This waste is then transferred into the satellite accumulation container in the Organic Prep. Lab. on a daily basis. This material is transferred into 5 gallon solvent cans as satellite accumulation. These cans are emptied every 24 hours into a steel drum in the waste room. This drum is kept in the walk in hood until it is full. The full drum is then removed from the hood and placed on secondary containment in the waste room.

  Teris Profile Number: 50016624
  Onyx Profile WIP Number: 545240

14.1. Pollution Prevention

14.2.1. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The USEPA has established a prevention hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the agency recommends recycling as the next best option.

14.2.2. The quantity of chemical purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

15.0. References / Cross-References

15.1. United States Environmental Protection Agency, “Method SW8270D, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry”, Test Methods for Evaluating Solid Wastes, SW846 Third Edition, Volume 1B: Laboratory Manual, Physical/Chemical Methods, Revision 4, February 2007.

15.2. United States Environmental Protection Agency, “Method SW8000C: Determinative Chromatographic Separations”, Test Methods for Evaluating Solid Wastes, SW846, Laboratory Manual, Physical/Chemical Methods, Revision 3, March 2003.

15.3. TestAmerica Edison Document No. ED-QA-LQM, *Laboratory Quality Manual*, current revision.

15.4. TestAmerica Edison SOP No. ED-ORP-002, *SW846 Method 3510C-Extraction of Semi-Volatile Organic Compounds in Water by Separatory Funnel,* current revision.

15.5. TestAmerica Edison SOP No. ED-ORP-043, *SW846 Method 3580A - Waste Dilution Prep for Analysis of BNAs by SW846 Method 8270,* current revision.

15.6. TestAmerica Edison SOP No. ED-ORP-044, *Procedure for the Microwave Extraction of Solids, SW3546, current revision.*

15.7. TestAmerica Edison SOP No. ED-ORP-006, SW846 *Method 3550B- Extraction of Semi-Volatile Organic Compounds in Soil Using Medium--level Extraction Technique,* current revision.

15.8. TestAmerica Document No. CW-E-M-001, Corporate Environmental Health and *Safety Manual,* current revision.

15.9. TestAmerica Corporate Quality SOP No. CA-Q-S-001, *Solvent & Acid Lot Testing & Approval*, current revision.

15.10. TestAmerica Edison SOP No. ED-GEN-023 (*Bulk Solvent Testing and Approval*), current revision.

15.11. TestAmerica Edison SOP No. ED-GCS-001, *Preparation and Screening of Semivolatile Organic Extracts for GC/MS Analysis*, current revision.

15.12. TestAmerica Edison Work Instruction Document No. EDS-WI-012, *Client Complaint/Corrective Action Form,* current revision.

15.13. TestAmerica Edison SOP No. ED-GEN-003, *Standard Operating Procedure for Control of Non-Conformances and Corrective Action,* current revision.

15.14. TestAmerica Edison SOP No. ED-ORP-001, *Extraction of Semivolatile Organic Compounds in Water, EPA Method 625,* current revision.

15.15. TestAmerica Edison SOP No. ED-GEN-022, *Training,* current revision.

15.16. TestAmerica Corporate Quality Memorandum, CA-Q-QM-002, *GC/MS Tuning Policy*, current revision.

16.0. Method Modifications:

N/A

17.0. Attachments

Attachment 1 Poor Performing Analytes

18.0. Revision History

- Revision 7, date 06/08/2018
    - Section 2.3: revised to clarify that RVE/LVI is lab standard procedure.
    - Section 9.1.3: removed statement regarding allowance for up to five analytes to recover outside of lab acceptance limits in LCS/LCSD.
    - Section 9.2.4.3: Replace table 'ICV Poor Performers (50-150% Recovery) with expanded list of 'Poor Performing Analytes' in Attachment 1.
    - Added Section 9.2.4.4.5: CCV Poor Performers
    - Corrected number in section 9.2.4.5
    - Added Attachment 1 – Poor Performing Analytes

- Revision 6, date 01/12/2018:
    - Section 7.2.5 included to specify reagent and standard storage conditions.
    - Revised Section 9.1.3 to clarify requirements for specific LCS/LCSD evaluation criteria regarding the # of out of criteria analytes.
    - Revised Section 9.2.4.3 to add 2,4-Dimethylphenol as a poor performing analyte, increased the range for the poor performers to 50-150 and also expanded the guidelines for flagging the ICV outliers.

- Revision 5, dated 09/29/2017:
    - Revised Section 9.1.1 to clarify requirements for surrogate recovery in method blanks.

- Revision 4, dated 08/21/2017:
  - Updated throughout to add a procedure for the analysis of 1,4-dioxane by isotope dilution selected ion monitoring (SIM)
  - Added tables for isotope dilution SIM standards. Renumbered all tables as necessary.
  - Section 7.2.1: added a list of full scan calibration list options.
  - Table 3: Renamed 'Full Scan Stock Standards'.
  - Section 9.2.1: noted that DFTTP applies only to full scan analysis.
  - Section 9.2.3: updated CCV concentrations
  - Added reference to GC/MS Tuning Policy in Section 15.16.

- Revision 3, dated 01/07/2016:
  - Tables 1 and 2: added SIM as option for 1,4-Dioxane.
  - Section 2.3: removed SW3541 (Soxtherm) as option for soils prep (lab has discontinued use of this method). Also removed SW3541 SOP reference from Section 15.0.
  - Tables 19 and 20: added source and prep instructions for 1,4-Dioxane SIM standard. Updated source and prep instructions for 4,6-Dinitro-2-methylphenol.
  - Table 22: added prep instructions for 1,4-Dioxane and 4,6-Dinitro-2-methylphenol SIM ICV standard.
  - Corrected the information in the 'DFTPP Key Ions and Abundance Criteria' table in Section 9.2.1 to match the info found in SW846 8270C.
  - Section 10.1.4.2: updated "SIM Parameters" to included ion masses/dwell times for 1,4-Dioxane.

- Revision 2, dated 01/28/2015:
  - Extensively reformatted the SOP. Placed tables that had been in rear of document into the body of the text. Renumbered tables as applicable and fixed text references to tables.
  - Section 1.1, Table 1: Revised table to include all current analytes. Also footnoted those compounds which are currently analyzed by SIM.
  - Section 2.3: added options for extraction of solids by SW846 3456 (Microwave Extraction) and by SW3580A (Waste Dilution) and added SOP references. Deleted reference to SOP ED-ORP-005 (SW3550B – Low Level); Updated Section 15 (References).
  - Section 2.5: added text detailing the RVE/LVI options.
  - Section 2.6: added table which includes all analytes routinely analyzed by SIM.
  - Section 6: updated to include newer GC, MS and autosampler models currently in use.
  - Section 6.1.3: added Zebron ZB column as an option.
  - Section 7.2: extensively revised standards information to reflect switch to Restek standards.
  - Table 3:Added Custom Aromatic Amine Surrogate Standard and revised Table 8 to include initial calibration prep instructions for the Aromatic Amine surrogates.
  - Throughout document: removed references to Target and replaced with Chrom.
  - Section 7.2.1: Added reference to section 10.2.1.2 for LVI.
  - Added Section 7.2.1.3.1 and Table 17A both of which discuss use of Aromatic Amine surrogates.
  - Section 7.2.1.2: Added reference to Tables 9,10 and 11 (ICV Preparation)
  - Section 8.0: Added Sample container and minimum sample size (250 ml) for

Reduced volume extraction.

  - Sections 9.1.2, 9.1.3, 9.1.4 and 9.2.4: added statement that certain state regulatory programs have defined recovery limits which, where applicable, are used for spike and calibration evaluations.
  - Section 9.1.2: Deleted sentence "A minimum of 16 spiked analytes are reported to in client reports (the full list is reported at least once during each 2 year period because we employ full spiking list.
  - Section 9.1.4: Added note regarding use of Aromatic Amine Surrogates.
  - Section 9.2.2.2: Added reference to ICV Preparation tables in Section 7.2.
  - Section 9.2.3: added more specific info as to the concentration of the CCVs for all techniques.
  - Section 9.2.4.2.1: Changed to reflect that each analyte should meet minimum RF's, not the average across the calibration. Added LLCCV requirement.
  - Section 10.3.1: added explanation of Chrom's interaction with TALS. Removed references to Target.
  - Section 9.2.4.2.5.5: Added: (or can be noted in the narrative)
  - Section 9.2.4.2.5.6: Revised last sentence to read: "This evaluation can be checked using the Initial Calibration %Drift Report in Chrom."
  - Section 9.2.4.3: Removed 65-135% criteria and added "poor performing" analyte list and associated criteria of 60-140%.
  - Section 9.2.4.4.3: Added LLCCV criterion for RFs
  - Section 9.2.4.4.4: Added LLCCV criterion for %D
  - Section 10.1.4: Updated GC/MS operating conditions for full scan, SIM and DFTPP.
  - Section 10.1.4.1: added a table detailing operating conditions for LVI option.
  - Table 2: Added 2-ethylaniline, 2,4-dimethylaniline, 3,4-dimethylaniline, 2,3-dimethylaniline, 2,4,5-trimethylaniline and 4-chloro-o-toluidine to Working Standards preparation information.
  - Table 25: updated to include all current analytis/surrogates/internal standards and associated ions.
  - Throughout document: updated LQM section references as appropriate as some have changed with the latest LQM revision.

- Revision 1, dated 11/07/2011

  - Section 1.1, Table 1: Added Pentachloronitrobenzene and associated CAS# to the analyte list.
  - Section 7.2.1: Added Pentachloronitrobenzene standard information.
  - Table 2: Added Pentachloronitrobenzene to Working Standards preparation information.
  - Table 4: Added Pentachloronitrobenzene and associated minimum RF.
  - Table 8: Added Pentachloronitrobenzene and associated ions.

- Revision 0, dated 02/22/2011: NEW

Table 31
Characteristic Ions Of Semi-Volatile Organic Compounds

Compound	Primary Ion	Secondary Ion(s)
1,1'-Biphenyl	154	153,76
1,2,4,5-Tetrachlorobenzene	216	214, 179
1,2,4-Trichlorobenzene	180	182, 145
1,2-Dichlorobenzene	146	148, 111
1,2-Diphenylhydrazine	77	105, 182
1,3-Dichlorobenzene	146	148, 111
1,3-Dimethylnaphthalene	156	141, 115
1,4-Dichlorobenzene	146	148, 111
1,4-Dichlorobenzene d4 **(ISTD)**	152	150, 115
1,4-Dioxane	88	58, 43
1-Methylnaphthalene	142	141, 115
1-Naphthylamine	143	115, 116
2,2'-oxybis[1-chloropropane]	45	77, 121
2,3,4,6-Tetrachlorophenol	232	131, 230
2,3,7,8-TCDD (screen)	320	322, 324
2,3-Dihydroindene		
2,3-Dimethylaniline	106	129
2,4,5-Trichlorophenol	196	198, 200
2,4,5-Trimethylaniline	102	55, 56
2,4,6-Tribromophenol **(Surrogate)**	330	132, 141
2,4,6-Trichlorophenol	196	198, 200
2,4-Dichlorophenol	162	164, 98
2,4-Xylidine	121	120, 106
2,4-Dimethylphenol	122	107, 121
2,4-Dinitrophenol	184	63, 154
2,4-Dinitrotoluene	165	63, 89
2,6-Dinitrotoluene	165	63, 89
2-Chloronaphthalene	162	127, 164
2-Chlorophenol	128	64, 130
2-Ethylaniline	106	122,104
2-Fluorobiphenyl **(Surrogate)**	172	171
2-Fluorophenol **(Surrogate)**	112	64
2-Methylnaphthalene	142	141
2-Methylphenol	108	107
2-Naphthylamine	143	115, 116
2-Nitroaniline	65	108, 138
2-Nitrophenol	139	109, 65
2-tert-butyl-4-Methylphenol	149	121, 91
2-Toluidine	107	106, 77
3,3'-Dichlorobenzidine	252	254, 126
3,4-Dimethylaniline	106	129, 127
3,5-Di-tert-butyl-4-Hydroxytol	205	220, 145
3-Nitroaniline	138	108, 65
4,6-Dinitro-2-methylphenol	198	51, 105
4-Bromophenyl phenyl ether	248	250, 141
4-chloro-2-methylaniline	106	144, 142

Table 31
Characteristic Ions Of Semi-Volatile Organic Compounds

Compound	**Primary Ion**	**Secondary Ion(s)**
4-Chloro-3-methylphenol	107	144, 142
4-Chloroaniline	127	129
4-Chloroaniline-d4 **(Surrogate)**	131	133
4-Chlorophenyl phenyl ether	204	206, 141
4-Methylphenol	108	107
4-Nitroaniline	138	108, 65
4-Nitrophenol	139	109, 65
Acenaphthene	154	153, 152
Acenaphthene d10 **(ISTD)**	164	162, 160
Acenaphthylene	152	151, 153
Acetophenone	105	77, 51
Aniline	93	66
Aniline-d5 **(Surrogate**)	98	71,42
Anthracene	178	176, 179
Atrazine	200	173,215
Benzaldehyde	77	105,106
Benzidine	184	92, 185
Benzo(a)anthracene	228	229, 226
Benzo(a)pyrene	252	253, 125
Benzo(b)fluoranthene	252	253, 125
Benzo(g,h,i)perylene	276	138, 277
Benzo(k)fluoranthene	252	253, 125
Benzoic Acid	122	105, 77
Benzyl Alcohol	108	79, 77
Bis(2-chloroethoxy)methane	93	95, 123
Bis(2-chloroethyl)ether	93	63, 95
Bis(2-ethylhexyl)phthalate	149	167, 279
Bisphenol-A	213	228, 119
Butyl benzyl phthalate	149	91, 206
Caprolactam	113	55,56
Carbamazepine	193	236, 135
Carbazole	167	166, 139
Chrysene	228	226, 229
Chrysene d12 **(ISTD)**	240	120, 136
Coumarin	146	118, 63
Dibenz(a,h)anthracene	278	139, 279
Dibenzofuran	168	139
Diethylphthalate	149	177, 150
Dimethylphthalate	163	194, 164
Di-n-butylphthalate	149	150, 104
Di-n-octylphthalate	149	167, 43
Fluoranthene	202	101, 203
Fluorene	166	165, 167
Hexachlorobenzene	284	142, 249
Hexachlorobutadiene	225	223, 227
Hexachlorocyclopentadiene	237	235, 272

Table 31
Characteristic Ions Of Semi-Volatile Organic Compounds

Compound	**Primary Ion**	**Secondary Ion(s)**
Hexachloroethane	117	201, 199
Indeno(1,2,3-cd)pyrene	276	138, 227
Isophorone	82	95,138
Kepone	272	237, 355
N,N-Dimethylaniline	120	122, 104
Naphthalene	128	129, 127
Naphthalene d8 **(ISTD)**	136	68
n-decane	43	57
Nitrobenzene	77	123, 65
Nitrobenzene-d5 **(Surrogate)**	82	128, 54
N-Nitrosodimethylamine	42	74, 44
N-Nitroso-di-n-propylamine	170	42,101,130
N-Nitrosodiphenylamine	169	168, 167
n-Octadecane	57	43, 85
o-Toluidine-d9 **(Surrogate)**	114	112, 42
Pentachloronitrobenzene	237	214,295
Pentachlorophenol	266	264, 268
Perylene d12 **(ISTD)**	264	260, 265
Phenanthrene	178	179, 176
Phenanthrene d10 **(ISTD)**	188	94, 80
Phenol	94	65, 66
Phenol-d5 **(Surrogate)**	99	42, 71
Phenyl ether	170	77, 115
Pyrene	202	200, 203
Pyridine	79	52, 51
Terphenyl-d14 **(Surrogate)**	244	122, 212

Attachment 1
Poor Performing Compounds

1,2,4,5-Tetrachlorobenzene
1,4-Dioxane
1-Naphthylamine
2,3,4,6-Tetrachlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2-Chloroaniline
2-Naphthylamine
3&4-Methylphenol
3’3-Dichlorobenzidine
4,6-Dinitro-2-methyl- phenol
4-Chloroaniline
4-Nitrophenol
Aniline
Atrazine
Benzaldehyde
Benzidine
Benzoic Acid
Benzyl Alcohol
Biphenyl
Caprolactam
Diphenylamine
Hexachlorocyclopentadiene
Hexachloroethane
n-Decane
n-Nitrosodimethylamine
o,o,o-Triethylphosphorothioate
o-Toluidine
Pentachloronitrobenzene
Pentachlorophenol
Phenol
Pyridine

These analytes are exempt from the ICV and CCV criteria as detailed in this SOP

Title: Per- and Poly-fluorinated Substances (PFAS) in Drinking Water and Non-Potable Water

[Method 537 (Modified)]

Approval Signatures:

Don Dawicki
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1.0 Scope and Application

This SOP describes the laboratory procedure for the preparation and analysis of per- and polyfluorinated substances using liquid chromatography/tandem mass spectrometry (LC/MS/MS).

Program specific requirements are not included in this SOP. The details of program specific requirements are specified in other laboratory work instructions relevant to the program.

1.1 Analytes, Matrices, and Reporting Limits

This procedure may be used for *drinking water and non-potable water.
***Matrices not certified for under Primary Accreditation Body (NJDEP). These matrices are project specific, therefore method modifications have been included throughout this SOP.**

The list of target compounds that may be determined from this procedure is provided below. Table 1 presents the compounds along with their associated reporting limits (RL).

Compound Name	Abbreviation	CAS #
Perfluoroalkylcarboxylic acids (PFCAs)		
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
Perfluoro-n-hexanoic acid	PFHxA	307-24-4
Perfluoro-n-heptanoic acid	PFHpA	375-85-9
Perfluoro-n-octanoic acid	PFOA	335-67-1
Perfluoro-n-nonanoic acid	PFNA	375-95-1
Perfluoro-n-decanoic acid	PFDA	335-76-2
Perfluoro-n-undecanoic acid	PFUdA (PFUnA)	2058-94-8
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8
Perfluoro-n-tetradecanoic acid	PFTeDA (PFTA)	376-06-7
Perfluorinated sulfonic acids (PFSAs)		
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5
Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-4
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1
Perfluoro-1-nonanesulfonic acid	PFNS	68259-12-1
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3
***Perfluorinated sulfonamides (FOSA)**		
*Perfluoro-1-octanesulfonamide	FOSA	754-91-6
***Perfluorinated sulfonamidoacetic acids (FOSAA)**		
*N-ethylperfluoro-1-octanesulfonamidoacetic acid	EtFOSAA	2991-50-6
*N-methylperfluoro-1-octanesulfonamidoacetic acid	MeFOSAA	2355-31-9
***Fluorotelomer sulfonates (FTS)**		
*1H,1H,2H,2H-perfluorohexane sulfonate *(4:2)*	4:2 FTS	757124-72-4
*1H,1H,2H,2H-perfluorooctane sulfonate *(6:2)*	6:2 FTS	27619-97-2
*1H,1H,2H,2H-perfluorodecane sulfonate *(8:2)*	8:2 FTS	39108-34-4

***Analytes are not certified under Primary Accreditation Body (NJDEP)**
Abbreviations in parenthesis are the abbreviations listed in Method 537, where they differ from the abbreviation used by the laboratory's LIMS.

The working range of the method is listed below. The linear range can be extended by diluting the extracts.

Matrix	Nominal Sample Size	Working Range
*Drinking Water (DW)	250 mL	2.0 ng/L - 400 µg/L
*Non-potable Water (NPW)	250 mL	2.0 ng/L - 400 µg/L

***Laboratory not certified for all analytes by PAB**

2.0 Summary of Method

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

The final 80:20 methanol:water extracts are analyzed by LC/MS/MS operated in electrospray (ESI) negative ion mode. PFAS are separated from other components on a C18 column with a solvent gradient program using 5mM ammonium acetate (aq) and methanol.

Most analytes employ the isotope dilution technique, where each analyte response is compared to the response of its isotopically labeled version. The isotope dilution analytes (IDA) consists of carbon-13 labeled analogs, oxygen-18 labeled analogs or deuterated analogs of the compounds of interest. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related interferences to the same extent as the compounds of concern. Compounds that do not have a labeled analog are quantitated by the IDA method using a closely related labeled analog.

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

This SOP is based on the following reference methods:

- US EPA, "Method 537 - Determination of Selected Perfluorinated alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometery (LC/MS/MS)", Version 1.1, September 2009.
- Method ISO 25101, "Water quality – Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) – Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry", First Edition, 2009-03-01, International Organization for Standardization, Technical Committee ISO/TC 147, Water Quality, Subcommittee SC 2, Physical, chemical and biochemical methods.

If the laboratory's SOP is modified from the reference method, a list of method modifications along with technical justification may be found in Section 16. Modifications to this SOP may be applied on a project specific basis to meet project data quality objectives. Project specific modifications are documented in the project record.

3.0 Definitions

Definitions of terms used in this SOP may be found in Appendix A.

4.0 Interferences

PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean. These items are listed below in Section 6.

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

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

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

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

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

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

Both branched and linear isomers of PFOS, PFOA, PFHxS, PFBS, EtFOSAA and MeFOSAA can potentially be found in the environment, based upon scientific literature. If multiple isomers are present for one of these PFAS, these adjacent peaks are either completely resolved or not resolved but with a profound deflection that can be resolved during peak integration. The later of the peaks matches the retention time of the single labeled PFAS peak. In general, earlier peaks are branched isomers and are not a result of peak splitting, and all the chromatographic peaks observed in the standard and/or sample must be integrated and the areas included. When reference standards of technical mixtures of specific PFAS area available, they should be used to ensure that all appropriate peaks are included during peak integration (at this time, only PFOS, PFOA, PFHxS, EtFOSAA and MeFOSAA are available as technical mixtures). Refer to Section 7, Reagents, for the available technical mixtures utilized by this SOP.

In an attempt to reduce PFOS bias, it is required that m/z 449>80 transition be used as the quantitation transition.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

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

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

The HPLC and MS/MS have areas of high voltage. Depending on the type of work involved, the instrument should be turned off or disconnected from its source of power prior to extensive maintenance.

5.2 Primary Materials Used

Table 2, Section 18.0 lists those materials used in this procedure that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the SDS. **NOTE: This list does not include all materials used in the method.** A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- 15 mL polypropylene test tubes with screw caps, Fisherbrand 05-539-5 or equivalent.
- 250-mL HDPE wide-mouth bottles with screw caps (ESS 0250-1901-).
- Analytical balance capable of weighing to the nearest 0.01g, and checked for accuracy each day it is used in accordance with BR-GT-008.
- SPE Vacuum manifold, 24-port, Restek # 26080 or equivalent.
- Polypropylene SPE Reservoir, 150mL, UCT # RFV00150P, or equivalent.
- 1/8” OD Poly siphon lines, 30” long for sample loading.
- SPE Adaptor Caps for 1, 3, and 6 mL SPE Tubes, Polyethylene, Phenomenex # AH0-7191, or equivalent.
- SPE Stopcocks, Polyethylene and Polypropylene, Restek # 26083, or equivalent.
- Stainless steel solvent guide needles, Supelco # 57036, or equivalent.

- Heavy-Wall filter flask, Fisherbrand 4000mL, #FB-300-4000, or equivalent.
- Glass-Col ZipVap 24-port extract concentrator.
- Polypropylene Syringe, 10 mL with luer-lok or luer slip tips, Norm-Ject AB10LL or equivalent.
- Volumetric Syringes, Class "A" (25µL, 50µL 100µL, and 500µL), Hamilton or equivalent.
- Automatic Pipettor, Finnpette, 1-5mL.
- Polypropylene autosampler vials, 300µL, 700µL and 2mL with polyethylene screw caps.
- Vacuum manifold for Solid Phase Extraction (SPE).
- Waters Oasis WAX 500 mg/6mL, (PN 186004647) or equivalent.
- 250mL Poly bottles containing 1.25g of Trizma Pre-Set Crystals, used for batch QC for samples received with Trizma preservation.

6.2 Analytical System

- HPLC: Waters Alliance/2795 with binary pumping capability, chilled sample compartment and heated column oven. All PTFE solvent lines have been replaced with PEEK to reduce the amount of contamination coming from the system.
- MSMS: Waters Quattro Premier tandem mass spectrometer.
- Instrument Software: MassLynx 4.1: Instrument control and data acquisition.
- Data Processing - Chrom Peak Review (Version 2.1 or later), Integrated with TALS (TestAmerica LIMS).
- Isolator Column: Restek Ultra C18 5µm, 10 x 2.1mm, two aligned in series. These are plumbed between the HPLC pump and autosampler valve to resolve system-based PFAS from sample-based PFAS.
- Analytical Column: Restek Raptor C18 5µm, 100 x 2.1mm, Cat No 9304512 or equivalent.

7.0 <u>Reagents and Standards</u>

7.1 Reagents

All reagents must follow traceability guidelines found in SOP BR-QA-002.

- Ammonium acetate Stock Solution, 100mM in 90/10 reagent water/MeOH. Prepare by adding 7.7g of ammonium acetate to 1L of 90/10 water/MeOH. The methanol is added to retard bacterial growth.
- Ammonium acetate Eluent, (5mM in water). Prepare by diluting the 100mM 20-fold in reagent water (Ex. add 25mL of ammonium acetate stock to 475mL of reagent water).
- Ammonium hydroxide (NH_4OH) (0.3% in methanol). Prepare by adding 3 mL of NH_4OH to 1 L of Methanol. Volume prepared may be adjusted based on usage/need.
- Reagent Water, house reverse-osmosis reagent water ("PFAS-Free" via in-house testing).
- Hexane
- Methanol, Ultra-Resi Analyzed. JT Baker or equivalent.
- Sodium hydroxide (NaOH), 0.1N, in water. Prepare by adding 4g of NaOH to 1 L water.

7.2 Standards

Purchase high purity, technical grade solids (96% or greater) or certified solutions from commercial vendors. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 4 ± 2℃. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation. PFBS, PFHxS, PFOS and many other PFAS are not available in the acid form, but rather as their corresponding salts, such as sodium or potassium. The standards are prepared and corrected for their salt content according to the equation below.

$\text{Mass}_{acid} = \text{Measured Mass}_{salt} \times \text{MW}_{acid} / \text{MW}_{salt}$
Where: MW_{acid} is the molecular weight of PFAA
MW_{salt} is the molecular weight of the purchased salt.

For example, the molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore, the amount of NaPFOS used must be multiplied by a factor of 0.956 to account for the amount of PFOS in the final solution.

Prepare calibration and working standards by diluting a known volume of stock standard in an appropriate solvent to the final volume needed to achieve the desired concentration. The recommended formulation for each standard used in this procedure is provided in Appendix B along with the recommended source materials, expiration dates and storage conditions.

A technical (qualitative) grade PFOA standard is analyzed initially, then after initial calibration when a new column is installed or when significant changes are made to the HPLC parameters. This solution is used as a reference for the PFOA isomers (branched and linear) retention times.

A second source solution for PFAS is purchased from the same vendor; the PFC-MXB contains most of the target analytes in this mixture and is used as an ICV. All compounds certified by the PAB are found in this mixture. A few compounds are not available in this mixture, may not be available as another lot, and are not available from another vendor. For these analytes only, a second analyst may prepare a second source standard from the same source as the ICAL to produce an ICV. The recommended concentration of the ICV standard should be in the mid-range of the calibration curve. The concentration may be adjusted if the initial calibration levels are changed or altered.

Extraction Spiking Solutions

PFAS Low Level LCS Solution, 20/200 ng/mL

The PFAS spike solution is prepared by diluting all PFAS to produce a solution containing each PFAS at a concentration of 20 ng/mL in methanol (except 4:2FTS, 6:2FTS, 8:2FTS, MeFOSAA and EtFOSAA, which are at 200 ng/mL).

PFAS LCS/Matrix Spike Solution, 400 ng/mL

The PFAS spike solution is prepared by diluting all PFAS to produce a solution containing each PFAS at a concentration of 400 ng/mL in methanol.

PFAS High Level LCS Solution, 1000 ng/mL

The PFAS spike solution is prepared by diluting all PFAS to produce a solution containing each PFAS at a concentration of 1000 ng/mL in methanol.

PFAS Isotope Dilution Analyte Solution, 1000 ng/mL

The PFAS-IDA solution is prepared by diluting all labeled PFAS to produce a solution containing each compound at a concentration of 1000 ng/mL in methanol.

Internal Standard Solution, $^{13}C_2$-PFOA, 5000 ng/mL

The internal standard solution is prepared by diluting the stock 50 µg/mL $^{13}C_2$-PFOA 10-fold in methanol.

See Appendix B for analyte lists and concentrations.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP, sampling requirements may be found in the published reference method. Water samples are collected in pre-cleaned 250 mL HDPE containers. Soil samples are collected in pre-cleaned 8 oz. HDPE containers. Other containers may also be suitable. Samples are chilled to 0-6℃ for shipment to the laboratory.

Listed below are recommended sample size, preservation and holding time requirements:

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]	Reference
DW	250 mL HDPE Bottle	250 mL	0-6℃ & Trizma (5g/L)	Extraction:14 days from collection Analysis: 28 days from extraction	Method 537
NPW	250 mL HDPE Bottle	250 mL	0-6℃ Trizma (5g/L) (if from a known chlorinated source)	14 days from collection	Method 537
Extract	700 µL Polypropylene (PP) Vial with HDPE Screw cap	NA	0-6℃	28 days from extraction	NJDEP guidance

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

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

9.0 Quality Control

9.1 Sample QC

When samples contain the preservative Trizma, all associated QC must be treated with the same preservative.

Initial Demonstration of Capability (IDOC) and Method Detection Limit (MDL) studies described in Section 12 must be acceptable before analysis of samples may begin.

Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence.

The laboratory prepares the following sample QC for each extraction batch (an extraction batch is limited to a maximum of 20 field samples of the same matrix processed using the same procedure and reagents within the same time period):

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 per extraction batch	See Table 3
Laboratory Control Sample (LCS)	1 per extraction batch (Spiking Level rotates between Low, Medium and High on a batch-by-batch basis)	See Table 3
LCS Duplicate (LCSD)	1 per extraction batch whenever insufficient sample is available for an MS/MSD/DU	See Table 3
*Matrix Spike (MS/MSD)	1 per extraction batch (if sufficient sample is available)	See Table 3
*Sample Duplicate (SD)	DW-1 per extraction batch (if sufficient sample is available); Non-DW matrices- client request if sufficient sample is available	See Table 3
Field Reagent Blank, FRB	Per client set of samples	See Table 3

*An NCM must be applied if there is insufficient volume for a duplicate

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially, when CCV fails and after major instrument maintenance	See Table 3
Initial Calibration Blank (ICB)	Immediately after ICAL	See Table 3
Second Source Verification (ICV)	Immediately after ICB	See Table 3
Continuing Calibration Verification (CCV)	Beginning, end and after every 10 field samples. Alternate between ICAL Levels 4, 3 and 5 (in order) throughout sequence	See Table 3

Continuing Calibration Verification Low (CCVL)	Immediately following Level 4 CCV at beginning of every non-ICAL analytical sequence	See Table 3
Isotope Dilution Analytes (IDA)	Added to Every injection (Standards, QC and Field Samples) at the same concentration	See Table 3

10.0 Procedure

One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a Non-Conformance Memo (NCM). The NCM process is described in more detail in SOP BR-QA-0016. The NCM shall be filed in the project file and addressed in the case narrative.

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

10.1 Water Sample Preparation

Visually inspect samples for the presence of settled and/or suspended sediment. If the amount of sediment is so great that the SPE cartridge will clog before the majority of the sample has eluted, filter the water sample through a glass fiber filter (Whatman GF/F Cat No 1825 090 or equivalent). Gravity or vacuum can be used to pass the sample through the filter. Prepare a filtration blank with any samples requiring filtration. File an NCM noting the need for filtration.

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

Due to the high surface activity of the analytes, filtration should be regarded as a last resort. All samples will be spiked with IDA and LCS/MS (where appropriate) prior to filtration; this will allow any losses caused by filtration to be monitored and corrected for.

NOTE: for samples which full volume extraction is not possible, care MUST be taken to ensure the actual sample volume that is extracted and documented in the sample worksheet notes.

Prepare two 250 mL aliquots of HPLC-grade water for the method blank and LCS.

Rotate the LCS concentration with each batch.

-Low Level LCS (50-150 %R), spike with 0.025mL of PFAS Low Level LCS Spike solution. This will result in sample concentrations at the method Reporting Limit.

-Medium Level LCS (70-130 %R), spike with 0.025 mL (25 µL) of the PFAS LCS/Matrix Spike solution (Section 7.2). This will result in a sample concentration of 40 ng/L.

-High level LCS (70-130 %R), spike at 0.05mL (50uL) of the PFAS High Level LCS Spike solution (Section 7.2). This will result in a sample concentration of 200 ng/L.

Spike the MS/MSD (if available volume) with 0.025 mL (25 µL) of the PFAS LCS/Matrix Spike solution (Section 7.2). This will result in a sample concentration of 40 ng/L. NCM if there is insufficient volume to perform the MS/MSD.

Add 0.025 mL (25 µL) of the PFAS-IDA solution (Section 7.2) into each sample and QC sample, for a fixed concentration of 50 ng/mL in the final sample vial.

Due to the surface active nature of the PFAS analytes, it is necessary to extract the entire sample as well as the container walls to maximize recovery. It is therefore ideal to receive full 250 mL HDPE bottles for each sample (and MS/MSD if sufficient volume is received) so the entire sample can be processed from that container.

Weigh each container to determine its pre-extraction mass (Gross Weight). Spike each container in the batch with PFAS-IDA solution. Spike the LCS and LCSD (or MS/MSD, if available volume) with PFAS LCS/Matrix solution. Shake to mix the contents. After the extraction has been completed, allow the container to completely dry (uncapped). Replace the cap and reweigh the container to determine the container mass (Tare Weight). The sample volume extracted can be determined by subtracting the Tare Weight from the Gross Weight. These calculations are captured in the PFAS water sample prep module (TALS Method 3535_IVWT and 25101_2009_SPE).

Solid Phase Extraction (SPE) of Aqueous Samples

Condition the SPE cartridges (Waters WAX, 500 mg/6 cc) by passing the following without drying the column.

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

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

Wash with 5.0 mL of 0.3% NH_4OH/methanol.

Wash with 5.0 mL of 0.1N NaOH/water. Close valve when ~ 1 mL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

Appropriately label the SPE cartridges.

Either add a reservoir or a poly siphon line to an adapter which has been firmly inserted into the SPE cartridge. If reservoirs are to be used, carefully pour the spiked samples into their respective reservoirs. If poly siphon lines are employed, place the other end of the line into the corresponding sample container.

Turn on the vacuum and pull the entire sample volume (minimum of 250 mL) through the cartridge at rate of approximately 2 to 5 drops per second (6-15 mL/minute).

Stop the sample elution when ~0.1 mL remains. Add ~5 mL of water to the SPE column and restart the elution to complete the loading process. The added water volume ensures there are no small sample droplets remaining that may be clinging to the wall of the SPE cartridge.

After the sample and water rinse has passed through the cartridge, allow the cartridge to completely dry with vacuum (this could take up to 90 minutes). The cartridge should return to a uniform color. NOTE: Remove and replace each cartridge during the drying process to ensure any water droplets that may be in the flow path are eliminated.

SPE Column Wash of Aqueous Samples with Hexane

Add 5 mL of hexane to each SPE column and allow to soak for five minutes, then elute to waste.

Load a second 5 mL of hexane and elute to waste (without a soaking period).

Allow the column to dry with vacuum for 5 to 10 minutes. Columns must be dried thoroughly before continuing. The cartridge should return to a uniform color. Wipe any remaining water droplets from the bottom of the stainless steel guide needles using a fresh Kimwipe for each needle prior to proceeding to the next step.

SPE Elution of Aqueous Samples

Place labeled 15 mL polypropylene test tubes as receiving tubes in the SPE manifold. Add 100 µL of reagent water to each test tube as a “keeper”.

Rinse the dried sample bottles with 5 mL of 0.3% NH_4OH/methanol and transfer to the corresponding SPE cartridge using a disposable glass pipet (NOTE: the sample container has molded ridges in the neck that can trap up to 0.5mL of the solvent rinsate; make sure to tip the container slightly to draw the rinsate out of the ridges). Allow the solution to soak the cartridge for 5 minutes and then elute into the 15 mL collection tube.

Repeat sample bottle to cartridge elution process with a second 5 mL aliquot of 0.3% NH_4OH/methanol (without the soaking period) The total collection should be approximately 10 mL.

Extract Concentration for Aqueous Samples

Using the ZipVap, concentrate each extract under a gentle stream of nitrogen using a warmed block heater (mild heat ~15-20°C below solvent boiling point; ZipVap set point is 53) until the volume is below 500µL. The concentration should take more than 1 hour to complete. If the concentration proceeds faster than 1 hour, adjust the block temperature and/or nitrogen flow rate to increase the concentration time.

Add methanol dropwise to each extract until the volume is 0.5mL as determined by comparing the volume to a reference vial prepared daily containing 400µL methanol and 100µL water, then vortex to mix well.

Add 5µL of 5000 ng/mL to each 0.5 mL extract and vortex to mix well.

Transfer a portion of the extract to a 300µL polypropylene autosampler vial (6 drops or approximately 60µL is sufficient). Archive the rest of the extracts in a 700µL PP autosampler vial for re-injection and dilution.

Seal the vials with polyethylene screw caps. Note: Teflon lined caps may not be used due to detection of low level concentration of PFAS.

10.2 Other types of Sample Cleanup

Freezing technique to remove lipids

If samples contain lipids, freeze the methanol extract and QC extracts at -20^{o}C for at least 1 hour. Collect the solvent layer.

Cleanup with graphitized carbon which may also be used to remove organic interferences.

Add 100 mg of graphitized carbon to each sample extract and QC extracts.

Shake vigorously and then let sit for 10 minutes.

Centrifuge each sample for 2 minutes at 1000 rpm.

Decant the solvent layer.

Concentrate each sample under a gentle stream of nitrogen to approximately 0.5 mL.

Add 200µL of Millipore water to each sample.

Bring the final volume to 1.0mL with methanol (80% methanol/20% water).

Filter through a 0.45 µm syringe filter as necessary or centrifuge the extracts to obtain a clear supernatant. *Note: Syringe filter should be checked for PFAS background before using.*

WARNING: Application of excessive pressure has caused disc filters to rupture and burst. Exercise discretion when filtering.

10.3 Instrument Operating Conditions

Suggested operating conditions are listed below for the Waters LCMS system:

<table>
<tr><th colspan="6">Recommended Instrument Operating Conditions</th></tr>
<tr><th colspan="6"><i>HPLC Conditions (Waters Alliance/2795 HPLC)</i></th></tr>
<tr><td>Column (Column temp = 40°C)</td><td colspan="5">Restek Raptor C18 5µm, 2.1 x 100 mm</td></tr>
<tr><td>Mobile Phase Composition</td><td colspan="5">A = 5 mM Ammonium Acetate (Aq) B = Methanol</td></tr>
<tr><td rowspan="8">Gradient Program</td><td>Time</td><td>%A</td><td>%B</td><td>Curve</td><td>Flow Rate mL/min.</td></tr>
<tr><td>0.00</td><td>90</td><td>10</td><td>6</td><td>0.55</td></tr>
<tr><td>0.10</td><td>45</td><td>55</td><td>6</td><td>0.55</td></tr>
<tr><td>10.00</td><td>5</td><td>95</td><td>6</td><td>0.55</td></tr>
<tr><td>11.00</td><td>5</td><td>95</td><td>6</td><td>0.55</td></tr>
<tr><td>11.01</td><td>90</td><td>10</td><td>6</td><td>0.55</td></tr>
<tr><td>14.75</td><td>90</td><td>10</td><td>6</td><td>0.55</td></tr>
<tr><td colspan="5">Maximum pressure limit = 5,000 psi</td></tr>
<tr><td>Injection Size</td><td colspan="5">20 µL (fixed amount throughout the sequence)</td></tr>
<tr><td>Run Time</td><td colspan="5">16 minutes (includes autosampler load and inject times)</td></tr>
<tr><th colspan="6"><i>Mass Spectrometer Interface Settings (Quattro Premier)</i></th></tr>
<tr><td colspan="3">MS Interface Mode</td><td colspan="3">ESI Negative Ion</td></tr>
<tr><td colspan="3">Capillary (kV)</td><td colspan="3">2.3</td></tr>
<tr><td colspan="3">Cone (V)</td><td colspan="3">Varies from 12 to 60</td></tr>
<tr><td colspan="3">Extractor (V)</td><td colspan="3">3</td></tr>
<tr><td colspan="3">Source Temp</td><td colspan="3">125ºC</td></tr>
<tr><td colspan="3">Desolvation Temp</td><td colspan="3">350ºC</td></tr>
<tr><td colspan="3">Cone Gas (nitrogen) Flow</td><td colspan="3">35 L/hour</td></tr>
<tr><td colspan="3">Desolvation Gas (nitrogen) Flow</td><td colspan="3">1000 L/hour</td></tr>
<tr><td colspan="3">Low Mass Resolution 1</td><td colspan="3">12.0</td></tr>
<tr><td colspan="3">High Mass Resolution 1</td><td colspan="3">15.0</td></tr>
<tr><td colspan="3">Ion Energy 1</td><td colspan="3">1.5</td></tr>
<tr><td colspan="3">Low Mass Resolution 2</td><td colspan="3">10.0</td></tr>
</table>

High Mass Resolution 2	13.0
Ion Energy 2	3.0
Collision Cell Pressure/Flow	1.33e-002/0.5 mL/min

Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (Quattro Premier XE)

Compound	Comments	Reaction (MRM)	Dwell (sec)	Cone Volt.	Col. Energy	Function #
PFBA	Native analyte	212.9 > 168.9	0.10	14	9	1
13C4 PFBA	IDA	216.9 > 171.5	0.02	16	10	1
PFPeA	Native analyte	262.9 > 218.8	0.05	16	9	2
13C5 PFPeA	IDA	267.7 > 222.6	0.02	15	9	2
PFBS	Native analyte	298.9 > 80	0.05	50	30	2
PFBS_2	Native analyte	298.9 > 98.9	0.05	50	25	2
13C3 PFBS	IDA	302 > 79.8	0.02	50	30	2
PFHxA	Native analyte	312.8 > 268.6	0.10	14	10	3
PFHxA_2	Native analyte	312.9 > 118.9	0.10	14	20	3
13C2 PFHxA	IDA	314.8 > 269.6	0.02	14	10	3
4:2FTS	Native analyte	327 > 306.7	0.10	40	20	3
PFPeS	Native analyte	348.9 > 80	0.08	55	30	3
PFPeS_2	Native analyte	348.9 > 98.9	0.08	55	30	3
PFHpA	Native analyte	362.9 > 318.8	0.05	15	11	4
PFHpA_2	Native analyte	362.9 > 168.9	0.05	15	16	4
13C4 PFHpA	IDA	366.9 > 321.8	0.02	13	9	4
PFHxS	Native analyte	398.9 > 80	0.05	50	40	4
PFHxS_2	Native analyte	398.9 > 98.9	0.05	50	32	4
18O2 PFHxS	IDA	402.9 > 83.8	0.02	50	40	4
PFOA	Native analyte	412.9 > 368.8	0.05	17	10	5
PFOA_2	Native analyte	412.9 > 168.9	0.05	17	16	5
13C2 PFOA	Internal Standard	414.9 > 369.8	0.02	17	10	5
13C4 PFOA	IDA	416.9 > 371.8	0.02	17	10	5
6:2FTS	Native analyte	426.6 > 406.6	0.05	40	25	5
M2-6:2FTS	IDA	428.6 > 408.6	0.05	40	24	5
PFHpS	Native analyte	448.9 > 80	0.05	55	40	5
PFHpS_2	Native analyte	448.9 > 98.9	0.05	55	35	5
PFNA	Native analyte	462.9 > 418.7	0.05	17	11	6
PFNA_2	Native analyte	462.9 > 168.9	0.05	17	19	6
13C5 PFNA	IDA	467.8 > 422.8	0.02	17	11	6
PFOS	Native analyte	498.8 > 80	0.08	55	45	6
PFOS_2	Native analyte	498.8 > 98.9	0.08	55	38	6
13C4 PFOS	IDA	502.9 > 80	0.02	55	45	6
PFDA	Native analyte	512.9 > 468.5	0.05	20	11	7

PFDA_2	Native analyte	512.9 > 168.9	0.05	20	19	7
13C2 PFDA	IDA	514.9 > 469.5	0.02	20	12	7
8:2FTS	Native analyte	526.8 > 506.5	0.05	54	28	7
M2-8:2FTS	IDA	528.8 > 508.8	0.02	55	28	7
PFNS	Native analyte	548.9 > 80	0.05	70	50	7
PFNS_2	Native analyte	548.9 > 98.9	0.05	70	40	7
MeFOSAA	Native analyte	569.9 > 418.7	0.05	35	20	7
d3-MeFOSAA	IDA	572.9 > 418.7	0.05	35	20	7
FOSA	Native analyte	497.9 > 78.1	0.05	55	30	8
13C8 FOSA	IDA	505.9 > 78	0.02	55	30	8
PFUdA	Native analyte	562.9 > 518.5	0.05	19	12	8
PFUdA_2	Native analyte	562.9 > 168.9	0.05	19	23	8
13C2 PFUdA	IDA	564.8 > 519.8	0.02	20	12	8
EtFOSAA	Native analyte	583.9 > 418.7	0.10	36	20	8
d5-EtFOSAA	IDA	588.9 > 418.7	0.05	36	20	8
PFDS	Native analyte	598.9 > 80	0.05	75	50	8
PFDS_2	Native analyte	598.9 > 98.9	0.05	75	42	8
PFDoA	Native analyte	612.9 > 568.5	0.05	20	13	9
PFDoA_2	Native analyte	612.9 > 168.9	0.05	20	25	9
13C2 PFDoA	IDA	614.9 > 569.5	0.02	20	13	9
PFTrDA	Native analyte	662.9 > 618.5	0.05	23	14	9
PFTrDA_2	Native analyte	662.9 > 168.9	0.05	23	25	9
PFTeDA	Native analyte	712.9 > 668.5	0.05	20	14	10
PFTeDA_2	Native analyte	712.9 > 168.9	0.05	20	25	10
13C2 PFTeDA	IDA	714.8 > 669.6	0.02	20	14	10

Recommended Instrument Operating Conditions

Retention Times & Quantitation (Quattro Premier)

Native Compounds	Typical Native RT (minutes)	IS analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	2.33	13C4 PFBA	2.33	Isotope Dilution
PFPeA	2.77	13C5 PFPeA	2.77	Isotope Dilution
PFBS	2.83	13C3 PFBS	2.83	Isotope Dilution
4:2FTS	3.15	13C3 PFBS	2.83	Internal Standard
PFHxA	3.21	13C2 PFHxA	3.21	Isotope Dilution
PFPeS	3.24	13C3 PFBS	2.83	Internal Standard
PFHpA	3.73	13C4 PFHpA	3.73	Isotope Dilution
PFHxS	3.77	18O2 PFHxS	3.77	Isotope Dilution
6:2FTS	4.33	M2-6:2FTS	4.33	Isotope Dilution
PFOA	4.39	13C4 PFOA	4.39	Isotope Dilution
PFHpS	4.45	13C4 PFOS	5.16	Internal Standard
PFNA	5.14	13C5 PFNA	5.14	Isotope Dilution
PFOS	5.16	13C4 PFOS	5.16	Isotope Dilution
8:2FTS	5.91	M2-8:2FTS	5.91	Isotope Dilution
PFDA	5.91	13C2 PFDA	5.91	Isotope Dilution
PFNS	5.94	13C4 PFOS	5.16	Internal Standard
MeFOSAA	6.27	d3-MeFOSAA	6.27	Isotope Dilution

EtFOSAA	6.64	d5-EtFOSAA	6.64	Isotope Dilution
PFDS	6.64	13C4 PFOS	5.16	Internal Standard
PFUdA	6.67	13C2 PFUdA	6.67	Isotope Dilution
FOSA	6.97	13C8 FOSA	6.97	Isotope Dilution
PFDoA	7.35	13C2 PFDoA	7.35	Isotope Dilution
PFTrDA	7.96	13C2 PFTeDA	8.51	Internal Standard
PFTeDA	8.51	13C2 PFTeDA	8.51	Isotope Dilution

10.4 Instrument Tuning

Instrument tuning is done initially when the method is first developed and thereafter as needed to maintain the sensitivity and selectivity of the method. Tuning is done by infusing each individual compound (native and IDA) into the MS/MS electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and calibrated if necessary. The mass assignments must be within ± 0.5 amu of the values shown in the table above.

10.5 Instrument Calibration

Perform initial calibration with a minimum of five calibration standards before any sample analysis (initial method set-up), whenever a new column is installed, when significant instrument maintenance has been performed, and when the CCV does not meet acceptance criteria. Significant instrument maintenance includes installing a new column, changing the proportioning valve, or changing components of the MS/MS system. A new calibration is not required following minor maintenance.

With the exception of the circumstances delineated in policy CA-Q-P-003, it is not acceptable to remove points from a calibration curve. In any event, at least five points must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points. The same injection volume must be used for all injections (standards and extracts).

Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used for the analyte if the response is non-linear.

For average response factor (RFa), the relative standard deviation (RSD) for all compounds quantitated by isotope dilution must be < 35% for the curve to be valid.

For average response factor (RFa), the relative standard deviation (RSD) for all compounds quantitated by internal standard (i.e. those compounds that do not have corresponding isotopically labeled analogs) must be < 50% for the curve to be valid.

For linear fit, the intercept of the line must be less than ½ the reporting limit, and the coefficient of determination (r2) must be greater than or equal to 0.990 for the curve to be considered valid (or the correlation coefficient (r) > 0.995).

Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

-Response must increase with increasing concentration.

-The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.

-There should be no carryover at or above 1/2 MRL after a high CAL standard.

-The low cal. point must recover to within 50-150%, and all others must recover to within 70-130%.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration or 1/x weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.5.1 Initial Calibration

Prepare the working calibration standards using the recommended formulations given in Appendix B ensuring the lowest calibration standard for each analyte is equal to or below the established RL. Unless otherwise specified on a project basis, use calibration levels 1 to 6 to establish the calibration curve for each analyte.

Prime the instrument by analyzing a minimum of 4 “primer” solutions consisting of 80/20 methanol/water. In general, an HPLC contains components made from PTFE, which enable the pumps to work with many types of organic solvents. Despite efforts to remove as much PTFE as possible, certain components cannot be replaced and contribute PFAS. The longer the system remains idle, the more PFAS that is yielded. Therefore these primers serve to reduce and stabilize the amount of PFAS that are contributed. Immediately following the primers is a Blank, the ICAL sequence (run in ascending order of Level 1 to Level 6), the ICB, the ICV and the first analytical window of extracts (up to 10 field samples). The data is acquired using MassLynx 4.1.

The Chrom Review data system generates calibration data by generating relative response factors (RRFs) based on the response of the target analyte and its corresponding Isotope Dilution Analyte (or Internal Standard) as well as their injection concentrations to ultimately generate Mean Response Factors. All analytes calibrated using IDA must have RSD values < 35%, all analytes calibrated using ISTD must have RSD values < 50%. The IDA compounds are also calibrated using an external RF model using response and concentration. The IDA RSD must be < 50%. Alternatively, a linear regression curve of concentration vs. peak area for each analyte relative to their corresponding IDA/ISTD and their concentrations calculates the correlation coefficient with 1/concentration weighting. The calibration must have a correlation coefficient (r) ≥ 0.995 ($r^2 \geq 0.990$). If criteria are not met, correct the problem and repeat calibration. Further analysis may not proceed without valid calibration.

10.5.2 Initial Calibration Blank (ICB)

Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of 80:20 methanol:water blank fortified with IDA solution at 50 ng/mL

The result for the calibration blank must be less than the reporting limit.

If the ICB is greater than the reporting limit then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.5.3 Second Source Calibration Verification (ICV)

Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

The recovery for the ICV must meet the appropriate following criteria:

The native analyte must be within or equal to 70-130% for all native analytes quantitated by isotope dilution.

The native analyte must be within or equal to 70-130% for all native analytes quantitated by internal standard (i.e. those compounds that do not have corresponding isotopically labeled analogs).

The IDA must be within or equal to 50-150%.

See Table 3 for corrective actions in the event that the ICV does not meet the criteria above.

10.5.4 Continuing Calibration Verification (CCV)

Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are usually at the mid-level range of the curve and should vary throughout the run. The curve and ICV do not need to be run every day. To start an analytical run a CCV can be analyzed and if it meets acceptance criteria a run can be started. In addition, the low standard in the curve must be analyzed and must be within ± 50% of the expected value.

The recovery for the CCV standards must be equal to or within 70-130% (50-150% for low level standards) for all natives quantitated by isotope dilution and for all natives quantitated by internal standard. The recovery for the IDA must be within or equal to 70-130% of the true value.

If this is not achieved, the instrument has drifted outside the calibration limits. If the CCV fails again following minor maintenance, the instrument must be recalibrated.

10.5.5 Isotope Dilution Analytes (IDA)

The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 10.1. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

IDA recoveries are flagged if they are outside of the acceptance limits. Quantitation by isotope dilution generally precludes any adverse effect on data quality due to IDA recoveries being outside of the acceptance limits as long as the signal-to-noise ratio is greater than 10:1.

Evaluate data quality for usability, flag and submit a non-conformance memo for any analytes outside of the recovery criteria, and report if data is deemed not adversely effected.

Re-extraction of samples should be performed if the signal-to-noise for any IDA is less than 10:1 or if the IDA recoveries fall below 10%.

Re-extraction may be necessary under other circumstances when data quality has been determined to be adversely affected.

10.6 Troubleshooting:

Check the following items in case of calibration failures:

Evaluate the failure to determine whether it affects all of the compounds in the ICAL equally. If one ICAL point appears low or high, reprep the curve and rerun, as the error was most likely prep-based. If only a subset of the analytes are affected, check the integration and chromatography to see if there are anomalies; if justifiable, correct the integration so it is consistent with the other ICAL levels.

If there are no peaks for all compounds or no peaks after a specific retention time, ensure that the HPLC pump is pumping properly; it may have shut down due to overpressure or has a leak. If the pump has shut down, confirm it is primed and replace the in-line filter. If the pressure climbs above expected levels, changing the guard column and even analytical column may be necessary. It’s best to chase high pressure sources from the pump forward (ie the post-pump in-line filter, isolator column, post-autosampler in-line filter, guard column, analytical column and MSMS inlet. If the pump is still pumping, check the system pressure. If it is lower than expected, check for leaks. Start with all connections, then move on to pump seals, especially if there are wide variations in pressure when pumping the same solvents at the same flow rates. If the pump is still pumping and the pressure is normal, check to make sure the MSMS is still functioning properly. Most issues with the MSMS system will be noted by the MassLynx software.

If there are peaks for all analytes, evaluate the peak shapes by comparing them to the ICAL chromatography. If the peaks have changed (shorter and wider), a new guard column may improve peak shape and bring the system back into compliance. If a new column is necessary, a new ICAL will be needed.

Preventive and routine maintenance is described in the table below

HPLC/MS/MS Preventative Maintenance
As Needed: Change pump seals. Change in-line filters in autosampler (HPLC). Check/replace in-line frit if excessive pressure or poor performance. Replace column if no change following in-line frit change. Replace fused silica tube in ESI interface. Clean lenses. Clean skimmer. Ballast rough pump 30 minutes.
Daily (When in use) Check solvent reservoirs for sufficient level of solvent. Verify that pump is primed, operating pulse free. Check needle wash reservoir for sufficient solvent. Verify capillary heater temperature functioning. Verify vaporizer heater temperature. Verify rough pump oil levels. Verify turbo-pump functioning. Verify nitrogen pressure for auxiliary and sheath gasses.

HPLC/MS/MS Preventative Maintenance
Verify that multiplier is functioning.

10.7 Sample Analysis

Place the field and QC samples in a sequence that begins with the calibration standards followed by the analysis of QC samples, field samples and continuing calibration verification standards (CCVs).

An example analytical sequence that includes initial calibration (ICAL) is provided below.

Injection Number	Lab Description
1	Primer 1
2	Primer 2
3	Primer 3
4	Primer 4
5	Blank
6	Calibration Level 1
7	Calibration Level 2
8	Calibration Level 3
9	Calibration Level 4
10	Calibration Level 5 (ICIS)
11	Calibration Level 6
12	Calibration Level 7
13	Calibration Level 8
14	Calibration Level 9
15	ICB
16	ICV
17	MB
18	LCS
19-28	(up to) 10 Field samples
29	CCV L7
30-39	(up to) 10 Field samples
40	MS
41	MSD
42	CCV L3
43	MB
44	LCS
45-54	(up to) 10 Field samples
55	CCV L5
56-65	(up to) 10 Field samples
66	MS
67	MSD
68	CCV L7

An example analytical sequence without ICAL:

Injection Number	Lab Description
1	Primer 1
2	Primer 2
3	Primer 3
4	Primer 4
5	CCV L5 (20 ng/mL)
6	CCV L1 (1.0 ng/mL)
7	CCV L4 (10 ng/mL)
8	MB
9	LCS
10-19	(up to) 10 Field samples
20	CCV L7
21-30	(up to) 10 Field samples
31	MS
32	MSD
33	CCV L3
34	MB
35	LCS
36-45	(up to) 10 Field samples
46	CCV L5
47-56	(up to) 10 Field samples
57	MS
58	MSD
59	CCV L7

Enter the sample ID's into the data acquisition program in the order the samples were placed in the autosampler and initiate the analytical sequence.

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

The data processing system identifies the target analytes by comparing the retention time of the peaks to the retention times of the initial calibration standards. The retention times of PFAS with labeled standards must be the same as that of the labeled IDA's to within 0.05 min. For PFAS with no labeled standards, the RT must be within ± 0.3 minutes of the ICV and CCV standards. *Note: The IS RT and native RT may be offset by 0.02 to 0.04 minutes.*

11.2 Quantitative Identification

The ICAL established in Section 10.7 is used to calculate concentrations for the extracts. The data processing system determines on-column concentration. Final results are calculated by the laboratory's LIMS information system (TALS).

Dilute and reanalyze samples whose results exceed the calibration range. The diluted analysis should result in a determination within the upper half of the calibration curve.

Check the results of samples analyzed immediately after high concentration samples (those with results above calibration range) for signs of carry-over. Reanalyze all samples suspected of carry -over.

11.3 Calculations

See Appendix C.

11.4 Data Review

Refer to laboratory SOP BR-QA-019 for additional instruction on the requirements for data review. The following sections summarize the general procedure as described in the data review SOP.

11.4.1 Primary Review

Review the chromatography and quantitation in the data processing system to confirm quantitative and qualitative identification of each target analyte. Perform and document manual integrations only if needed per the instructions in corporate policy CA-Q-S-002, Acceptable Manual Integration Practices.

Upload the data files to TALS and process the batch. Enter job information into the batch editor and add the standards and reagent additions to the worksheet, if necessary. Review the results against acceptance criteria. If acceptance criteria are not met, perform corrective action or make arrangements for corrective action with another analyst.

Set results to primary, secondary, acceptable or rejected. Set results to be reported to a status of primary and secondary. Set results that meet criteria but will not be reported to acceptable. Set results that do not meet criteria to rejected, to prevent inadvertent reporting of data.

Verify that all appropriate QC were performed and acceptable. If insufficient volume is received (MS, MSD, FRB, etc…) document in an NCM. Record all instances where acceptance criteria are not met in a nonconformance memo (NCM).

Verify that all project requirements or program specific requirements were followed. If not, immediately notify the project manager to determine an appropriate course of action. Record decisions made in the data review checklist.

Set the batch to 1st level review. Complete the data review checklist and make arrangements for secondary review by a peer analyst.

11.4.2 Secondary Data Review (Performed by Peer Analyst)

Record review using the data review checklist.

Verify that all project requirements or program specific requirements were followed. If not, consult with the primary analyst to determine cause. Any decisions made should be recorded on the data review checklist and retained as part of the analytical record.

Review the TALS batch editor to verify ancillary information for the work performed is filled in.

Verify that that the procedures in this SOP were followed. If discrepancy between the SOP and the analytical record is found, consult with the primary analyst to determine the source of the discrepancy. Resolve the discrepancy and verify any modifications to the SOP are properly documented and were approved by laboratory management. Record all SOP deviations in an NCM.

Spot-check ~15% of samples in the batch to verify quantitative and qualitative identification.

If manual integrations were performed:

- Review each manual integration to verify that the integration is consistent and compliant with the requirements specified in SOP CA-Q-S-002.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in SOP CA-Q-S-002.

- If an error is suspected, the reviewer must consult with the analyst that performed the integration to determine if a correction is necessary. Input from the Technical Manager (TM), Department Manager (DM), or QA Manager (QAM) may be sought as necessary. **The reviewer may not reintegrate except in those circumstances approved by laboratory management**, such as when the analyst that performed the integration is on vacation. If re-integration is performed by the reviewer, the reviewer is now considered the “primary analyst” and the re-integration is subject to the same review and documentation requirements as the original integration.

Verify acceptance criteria were met. If not, verify that corrective actions were performed and the nonconformance was documented with an NCM. Review the NCM to verify the form is filled out and the requisite information has been included in the internal comments tab. If corrective action was not performed and the failure not documented, consult with the primary analyst to determine cause. Consult with the primary analyst and department management to determine what actions should be taken, then follow-through with the decision made.

Run the QC checker and fix any problems found. Run and review the deliverable for gross error such as missing data. Fix any problems found.

When review is complete set the method chain to lab complete. Complete the data review checklist and forward associated paperwork to report/project management.

11.4.3 Data Reporting & Record Retention

The specifications for data reporting are set by the project manager and are performed by TALS using the formatter selected by the PM. The type of deliverable is also set by the PM based on various deliverable options in the TALS system. The formatters and deliverables are programmed into TALS by corporate IT staff and cannot be modified locally.

The following sections describe the default reporting scheme set for this method in TALS:

Data is retained, managed and archived as specified in laboratory SOP BR-QA-014 Laboratory Records.

12.0 Method Performance

12.1 Detection Limit (DL), Limit of Detection (LOD) and Limit of Quantitation (LOQ)

See SOP BR-QA-005.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts must also have documentation of initial demonstration of initial proficiency (IDOC) for the test method prior to independent work. On-going proficiency (ODOC) must be demonstrated annually thereafter.

Initial Demonstration of Capability:
Analyze four mid level LCS replicates. These replicates must include all preservatives used in sample collection. The RSD between replicates must be within +/-20%. The average recovery of the replicates must be within +/-30% of the true value. Peak asymmetry factors must be calculated from the first two peaks in the CCV using the formula in Appendix C and must meet in the range 0.8-1.5. If any of these criteria are not met, the issue must be investigated, and the IDOC must be re-prepared and re-analyzed.

13.0 Pollution Control

It is Test America's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for “Waste Management and Pollution Prevention.”

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001. The following waste streams are produced when this method is carried out.

- Vials containing sample extracts: Satellite Container: 30 gallon poly barrel located under GC-Semi prep hood.
- Solvent Waste: Satellite Container: 5 gallon poly carboy located under LCMSMS.

15.0 References / Cross References

- Cheryl Moody, Wai Chi Kwan, Johnathan W. Martin, Derek C. G. Muir, Scott A. Mabury, “Determination of Perfluorinated Surfactants in Surface Water Samples by Two Independent Analytical Techniques: Liquid Chromatography/Tandem Mass Spectrometry and 19FNMR,” Analytical Chemistry 2001, 73, 2200-2206.
- John Giesy et al., “Accumulation of Perfluorooctane Sulfonate in Marine Mammals”, Environmental Science & Technology, 2001 Vol. 35, No. 8, pages 1593-1598.
- U.S. EPA, “Residue Chemistry Test Guidelines, OPPTS 860.1340, Residue Analytical Method”, EPA 712-C-95-174, August 1995.
- STL Denver White Paper DEN-W-LC-002, “Method Validation Study for Analysis of Ammonium Perfluorooctanoate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)”, Mark Dymerski, September 5, 2003.
- STL Denver White Paper DEN-W-LC-003, “Addendum A to Method Validation Study for Analysis of Ammonium Perfluorooctanoate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)”, Mark Dymerski, August 6, 2003.
- STL Denver White Paper DEN-W-LC-004, “Method Validation Study for Analysis of Perfluorooctanoic Acid in Waters by High Performance Liquid Chromatography/Tandem Mass Spectrometry (HPLC/MS/MS)”, Mark Dymerski, January 26, 2005.
- Waters application note; “Acquity UPLC System for Quantifying Trace Levels of Perfluorinated Compounds with an Acquity PFC Analysis Kit”, Peter J. Lee, Evan T. Bernier, Gordon T. Fujimoto, Jeremy Shia, Michael S. Young, and Alice J. Di Gloia, Waters Corporation, Milford, MA. USA.
- Method ISO 25101, “Water quality – Determination of perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) – Method for unfiltered samples using solid phase extraction and liquid chromatography/mass spectrometry”, First Edition, 2009-03-01, International Organization for Standardization, Technical Committee ISO/TC 147, Water Quality, Subcommittee SC 2, Physical, chemical and biochemical methods.
- US EPA, “Method 537 - Determination of Selected Perfluorinated alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometery (LC/MS/MS)”, Version 1.1, September 2009, J.A. Shoemaker, P.E. Grimmett, B.K. Boutin, EPA Document #: EPA/600/R-08/092.
- Laboratory SOP BR-QA-005 *Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).*
- Laboratory SOP BR-QA-011 *Employee Training*
- Laboratory SOP BR-EH-001 *Hazardous Waste*

- Laboratory SOP BR-QA-014 *Laboratory Records*
- Laboratory SOP BR-QA-006 *Procedures & Documentation Requirements for Manual Integration*
- Laboratory Quality Assurance Manual (QAM)

16.0 Method Modifications

Modification Number	Method Reference	Modification & Technical Justification
1	Section 7.2	Method 25101 specifies that the values reported for PFOA and PFOS shall be the linear isomer only. In keeping with the dictates of USEPA 537 and other US conventions, the laboratory reports both the branched (when present) and linear isomers as a single value for these compounds.
2	Section 10.1	A different SPE cartridge, Waters OASIS WAX, is used for the extraction process. As a result, solvents and elution procedures are different.
3	Section 10.1	The samples are fortified with a greater number of labeled analytes (most analytes have labeled versions) prior to extraction.
4	Section 10.5	The HPLC Column, Eluents and gradient conditions have changed.
5	Section 10.5	For non-drinking water matrices, the analyte list has expanded. The number of labeled analytes has also expanded to improve quantitation.
6	Table 1	The reporting limits have changed to a consistent value.
7	Appendix B	Calibration levels have been changed so all levels have the same analyte concentration.

17.0 Attachments

- Table 1: Routine Compound List and LOQ
- Table 2: Primary Materials Used
- Table 3: QC Summary & Recommended Corrective Action
- Table 4: Control Limits
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: Equations

18.0 Revision History (all revision history must be retained in this SOP)

Revision 3.0

- Updated cover page dates and signatories
- Section 10.1: added note for handling incomplete volume extraction process
- Section 18: added previous revision history back into SOP
- Throughout: updated QC criteria from EPA 537 r1.1 that was missed in previous revision
- Throughout: removed solid extraction/analysis verbiage missed in previous revision.
- Throughout: updated calibration to include criteria from EPA 537 r1.1 and to include the 9 calibration points currently in use.
- Throughout: minor formatting updates

Rev 2.1:

- Updated cover page dates and signatories
- Section 8: added preservation requirements for DW samples.
- Throughout: updated QC criteria to match EPA537 rev1.1
- Throughout: removed references to solid and tissue extraction/analysis.

Rev 2.0

- Updated cover page and signatories
- Section 8: added preservation requirements for DW samples.
- Throughout: included verbiage that Non-drinking water matrices are not certified under PAB.
- Throughout: separated DW and non-DW limits and QC requirements.
- Throughout: minor formatting and typographical corrections.
- Tables 3 & 4: updated limit to meet EPA 537 criteria.
- Appendix A: updated terms and definitions from body of SOP

Rev 1.0

- Extended analyte list to 21 native compounds and 18 IDAs.
- Altered concentration step in extract preparation by employing a reagent water keeper instead of concentrating to dryness.
- Incorporated use of internal standard for IDA recovery calculation.

Revision 0.0: 05/19/2017

- New SOP based on USEPA method 537

Previous revisions are retained by the QA department.

Table 1: Routine Compound List & Limit of Quantitation (LOQ)

Compound Name	Abbreviation	CAS #	Water (ng/L)
Perfluoroalkylcarboxylic acids (PFCAs)			
Perfluoro-n-butanoic acid	PFBA	375-22-4	2.0
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3	2.0
Perfluoro-n-hexanoic acid	PFHxA	307-24-4	2.0
Perfluoro-n-heptanoic acid	PFHpA	375-85-9	2.0
Perfluoro-n-octanoic acid	PFOA	335-67-1	2.0
Perfluoro-n-nonanoic acid	PFNA	375-95-1	2.0
Perfluoro-n-decanoic acid	PFDA	335-76-2	2.0
Perfluoro-n-undecanoic acid	PFUdA	2058-94-8	2.0
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1	2.0
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8	2.0
Perfluoro-n-tetradecanoic acid	PFTeDA	376-06-7	2.0
Perfluorinated sulfonic acids (PFSAs)			
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5	2.0
Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-4	
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4	2.0
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8	2.0
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1	2.0
Perfluoro-1-nonanesulfonic acid	PFNS	68259-12-1	
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3	2.0
Perfluorinated sulfonamides (FOSA)			
Perfluoro-1-octanesulfonamide	FOSA	754-91-6	2.0
Perfluorinated sulfonamidoacetic acids (FOSAA)			
N-ethylperfluoro-1-octanesulfonamidoacetic acid	EtFOSAA	2991-50-6	20.0
N-methylperfluoro-1-octanesulfonamidoacetic acid	MeFOSAA	2355-31-9	20.0
Fluorotelomer sulfonates (FTS)			
1H,1H,2H,2H-perfluorohexane sulfonate *(4:2)*	4:2 FTS	757124-72-4	20.0
1H,1H,2H,2H-perfluorooctane sulfonate *(6:2)*	6:2 FTS	27619-97-2	20.0
1H,1H,2H,2H-perfluorodecane sulfonate *(8:2)*	8:2 FTS	39108-34-4	20.0

NOTE: The LOQ values for waters and soils may vary. The Water LOQ is based on a 250mL nominal sample volume. The Soil LOQs represent those that can be achieved in a blank matrix with zero percent moisture. Actual LOQ values will vary with sample matrix, co-extracted interferences and percent moisture in sample. The Soil LOQ is applicable to 5 g sample extraction weight.

Table 2: Primary Materials Used

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Acetic Acid (3-2-1)	Corrosive Poison Flammable	10 ppm-TWA 15 ppm-STEL	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.
Ammonium Hydroxide (3-0-0)	Corrosive Poison	50 ppm-TWA	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal.
Hexane (2-3-0)	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Hydrochloric Acid (3-0-1)	Corrosive Poison	5 ppm (Ceiling)	Can cause pain and severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause deep ulcerations to skin, permanent eye damage, circulatory failure and swallowing may be fatal.
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm (TWA)	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Potassium Hydroxide (3-0-1)	Corrosive Poison		Severe irritant. Can cause severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause severe scarring of tissue, blindness, and may be fatal if swallowed.
Potassium Persulfate (2-0-1-OX)	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.

[1] Always add acid to water to prevent violent reactions.
[2] Exposure limit refers to the OSHA regulatory exposure limit.

Table 3: QC Summary, Acceptance Criteria and Recommended Corrective Action (EPA537)

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
9-Point Calibration (5 point minimum for CF and Linear Regression) (ICAL)	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	CF = RSD ≤ 35% (compounds calibrated via IDA) CF = RSD ≤ 50% (compounds calibrated using “near-IDA” compounds) CF = RSD ≤ 50% (IDA standards using ISTD) Each cal pt. = +/-30%Rec. (+/-50%Rec for cal low pt.) Linear Regression: $r^2 \geq 0.990$	Correct problem and repeat initial calibration.
IDA Response	Every injection contains the IDA analytes	DW: 70-130% recovery Non-DW matrices: Standards: 50-150% recovery Field samples: 50-150% recovery (reportable if >10x S/N ratio and >10% ICAL RF)	Standard failures must be investigated to determine the cause of the failure. Recalibration may be required. Samples with recoveries outside acceptance limits must be evaluated for data usability. Re-extraction may be necessary if data quality has been adversely affected.
IS Response	Every injection contains the IS analyte	ICAL Standards: Area of individual points must not deviate by more than 50% of ICAL mean area response Samples following ICAL: 50-150% of ICAL mean response Ongoing CCV: 70-130% (50-150% for non-DW) of ICAL mean response Post-CCV Samples: Area must be within 50-150% of most recent CCV	Standard failures must be investigated to determine the cause of the failure. Recalibration may be required. Sample failures may be matrix related and should be evaluated to determine if the data quality has been adversely affected.
Initial Calibration Blank (ICB)	Immediately following the ICAL	DW: < 1/3 RL for all target analytes Non-DW: < RL for all target analytes	Determine source of interference/contamination, eliminate it and recalibrate.
Second Source Standard Verification (ICV)	Prior to the analysis of samples. Generally immediately after the ICB.	+/-30 for analytes, IS, and SUR.	Correct problem and verify second source standard. If that fails, repeat calibration.
Continuing Calibration Verification (CCV)	Beginning of each analytical sequence, every ten field samples and at the end of each analytical sequence. Alternate between levels 3, 4 and 5.	+/-30%	Rerun any samples analyzed before and after the failing CCV. Take corrective action; if subsequent CCV analyses fail, recalibrate instrument.
Continuing Calibration Verification-Low (CCVL)	Beginning of each analytical sequence that is not preceded by an ICAL to show LOQ is still valid.	Non-DW: CF = 50-150% (IDA targets) CF = 50-150% (ISTD targets) IDA 50-150%	Stop sample acquisition. Take corrective action; if subsequent CCV analyses fail, recalibrate instrument.
Method Blank	One per extraction batch of 20 or fewer samples	DW: < 1/3 RL for all target analytes Non-DW: < RL for all target analytes	Reprocess MB and associated samples if any target analyte in the MB is at or above the RL, greater than 1/10 the amount detected in any sample or 1/10 the regulatory limit, whichever is greater. If the target is not greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with appropriate qualifiers. If insufficient sample is available to reprocess, report data with appropriate qualifiers.
Laboratory Control Sample	One per extraction batch of 20 or fewer samples (rotate between Low, Med, High)	%R within control limits. See Table 4	Reprep and reanalyze samples for failed analytes. If reanalysis is not possible due to insufficient sample volume, report data with appropriate data qualifiers.

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action
Matrix Spike / Matrix Spike Duplicate	One set per extraction batch when sufficient sample volume is provided	%R within control limits. See Table 4	Evaluate to determine if there is a matrix effect or analytical error. If analytical error, reanalyze or reprocess as appropriate.
Sample Duplicate	One per extraction batch of 20 or fewer samples	RPD within control limits. See Table 4	Evaluate data to determine source for error. If analytical error is suspected, reanalyze or reprocess as appropriate.
Field Reagent Blank	Per client sample set	DW: < 1/3 RL for all target analytes Non-DW: < RL for all target analytes	Analysis only required if samples contain target analytes at or above the RL. If analytes are present in the FRB at >1/3 RL, all samples must be recollected and re-analyzed.

Table 4: LCS and MS/MSD Control Limits*

Analyte	Water (Low Level) %R	Water (Med-High Level) %R	RPD
Perfluorobutanoic acid (PFBA)	50-150	70-130	20
Perfluoropentanoic acid (PFPeA)	50-150	70-130	20
Perfluorobutanesulfonic acid (PFBS)	50-150	70-130	20
Perfluorohexanoic acid (PFHxA)	50-150	70-130	20
Perfluoropentanesulfonic acid (PFPeS)	50-150	70-130	20
Perfluoroheptanoic acid (PFHpA)	50-150	70-130	20
Perfluorohexanesulfonic acid (PFHxS)	50-150	70-130	20
Perfluorooctanoic acid (PFOA)	50-150	70-130	20
Perfluoroheptanesulfonic acid (PFHpS)	50-150	70-130	20
Perfluorononanoic acid (PFNA)	50-150	70-130	20
Perfluorooctanesulfonic acid (PFOS)	50-150	70-130	20
Perfluorodecanoic acid (PFDA)	50-150	70-130	20
Perfluorononanesulfonic acid (PFNS)	50-150	70-130	20
Perfluoroundecanoic acid (PFUdA)	50-150	70-130	20
Perfluorodecanesulfonic acid (PFDS)	50-150	70-130	20
Perfluorooctanesulfonamide (FOSA)	50-150	70-130	20
Perfluorododecanoic acid (PFDoA)	50-150	70-130	20
Perfluorotridecanoic acid (PFTrDA)	50-150	70-130	20
Perfluorotetradecanoic acid (PFTeDA)	50-150	70-130	20
1H,1H,2H,2H Perfluorohexanesulfonate (4:2FTS)	50-150	70-130	20
1H,1H,2H,2H Perfluorooctanesulfonate (6:2FTS)	50-150	70-130	20
1H,1H,2H,2H Perfluorodecanesulfonate (8:2FTS)	50-150	70-130	20
N-Methyl Perfluorooctane sulfonamidoacetic acid (N-MeFOSAA)	50-150	70-130	20
N-Ethyl Perfluorooctane sulfonamidoacetic acid (N-EtFOSAA)	50-150	70-130	20

**The limits in this table are those in effect as of the published date of this SOP. The %R limits are specified by EPA 537r1.1 in sections 9.33, 9.36, and 9.37. The RPD the lab uses is more strict than those referenced in EPA 537 r1.1. If the lab makes changes to any of these limits, the updated limits will be no less strict than those specified in EPA537.*

Appendix A: Terms and Definitions

PFCAs: Perfluorocarboxylic acids

PFSAs: Perfluorinated sulfonates

FOSA: Perfluorinated sulfonamide

PFOA: Perfluorooctanoic acid

APFO: Ammonium perfluorooctanoate

PFOS: Perfluorooctane sulfonate

MPFOA: Perfluoro-n-[1,2,3,4-13C4]octanoic acid. Carbon-13 labeled PFOA

MPFOS: Perfluoro-1-[1,2,3,4-13C4]octanesulfonate. Carbon-13 labeled PFOS

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

SPE: Solid phase extraction**.**

PP: Polypropylene

PE: Polyethylene

HDPE: High density polyethylene

IDA: Isotope dilution analytes

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike (MS): a field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate (MSD): a second replicate matrix spike

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are only produced in this range and qualified with the proper data reporting flag when a project requires this type of data reporting.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Preservation: refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Standard: a solution made with one or more neat standards usually with a high concentration. Also known as a primary standard. Stock standards may be certified solutions purchased from a vendor.

Surrogate: a substance with properties that mimic the analyte of interest but that are unlikely to be found in environmental samples.

Appendix B: Standard Preparation Tables

The standard formulations contained in this appendix are recommended and are subject to change. If the concentration of the stock standard is different than those noted in this table, adjust the standard preparation formulation accordingly. Unless otherwise specified, prepare the standard solutions in methanol using Class A volumetric glassware and Hamilton syringes and assign an expiration date of 1 year from date of preparation unless the parent standard expires sooner; then use the earlier date. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance. For stock standards solutions made from neat material, assign an expiration date of 2 years from the date of formulation.

Stock Standard Solutions

PFAS LCS/Matrix Spike Solution 1000 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc (ng/mL)
PFBA	Wellington Laboratories Code: PFBA	Perfluorobutanoic acid	50	200	10	1000
PFPeA	Wellington Laboratories Code: PFPeA	Perfluoropentanoic acid	50	200		1000
PFBS	Wellington Laboratories Code: L-PFBS	Perfluorobutanesulfonic acid	44.2	200		884
PFHxA	Wellington Laboratories Code: PFHxA	Perfluorohexanoic acid	50	200		1000
PFPeS	Wellington Laboratories Code: L-PFPeS	Perfluoropentanesulfonic acid	46.9	200		938
PFHpA	Wellington Laboratories Code: PFHpA	Perfluoroheptanoic acid	50	200		1000
PFHxSK	Wellington Laboratories Code: br-PFHxSK	Perfluorohexanesulfonic acid	45.5	200		910
PFOA	Wellington Laboratories Code: PFOA	Perfluorooctanoic acid	50	200		1000
PFHpS	Wellington Laboratories Code: L-PFHpS	Perfluoroheptanesulfonic acid	47.6	200		952
PFNA	Wellington Laboratories Code: PFNA	Perfluorononanoic acid	50	200		1000
PFOS	Wellington Laboratories Code: br-PFOSK	Perfluorooctanesulfonic acid	46.4	200		928
PFDA	Wellington Laboratories Code: PFDA	Perfluorodecanoic acid	50	200		1000
PFNS	Wellington Laboratories Code: L-PFNS	Perfluorononanesulfonic acid	48.0	200		960
PFUdA	Wellington Laboratories Code: PFUdA	Perfluoroundecanoic acid	50	200		1000
PFDS	Wellington Laboratories Code: L-PFDS	Perfluorodecanesulfonic acid	48.2	200		964
FOSA	Wellington Laboratories Code: FOSA-I	Perfluorooctane sulfonamide	50	200		1000
PFDoA	Wellington Laboratories Code: PFDoA	Perfluorododecanoic acid	50	200		1000
PFTrDA	Wellington Laboratories Code: PFTrDA	Perfluorotridecanoic acid	50	200		1000
PFTeDA	Wellington Laboratories Code: PFTeDA	Perfluorotetradecanoic acid	50	200		1000
4:2FTS	Wellington Laboratories Code: 4:2FTS	1H,1H,2H,2H-perfluorohexane sulfonate (4:2)	46.7	200		934
6:2FTS	Wellington Laboratories Code: 6:2FTS	1H,1H,2H,2H-perfluorooctane sulfonate (6:2)	47.4	200		948
8:2FTS	Wellington Laboratories Code: 8:2FTS	1H,1H,2H,2H-perfluorodecane sulfonate (8:2)	47.9	200		958
NMeFOSAA	Wellington Laboratories Code: br-NMeFOSAA	N-methyl Perfluorooctane sulfonamidoacetic acid	50	200		1000
NEtFOSAA	Wellington Laboratories Code: br-NEtFOSAA	N-ethyl Perfluorooctane sulfonamidoacetic acid	50	200		1000

Solvent: Methanol

PFAS-IDA Solution (Surrogate) 1000 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc (ng/mL)
13C4 PFBA	Wellington Laboratories Code: MPFBA	$^{13}C_4$-Perfluorobutanoic acid	50	200	10	1000
13C5-PFPeA	Wellington Laboratories Code: MPFPeA	$^{13}C_5$-Perfluoropentanoic acid	50	200		1000
13C3-PFBS	Wellington Laboratories Code: M3PFBS	$^{13}C_3$-Perfluorobutanesulfonic acid	46.5	200		930
13C2 PFHxA	Wellington Laboratories Code: MPFHxA	$^{13}C_2$-Perfluorohexanoic acid	50	200		1000
13C4 PFHpA	Wellington Laboratories Code: M4PFHpA	$^{13}C_4$-Perfluoroheptanoic acid	50	200		1000
18O2 PFHxS	Wellington Laboratories Code: MPFHxS	$^{18}O_2$-Perfluorohexanesulfonic acid	47.3	200		946
13C4 PFOA	Wellington Laboratories Code: MPFOA	$^{13}C_4$-Perfluorooctanoic acid	50.0	200		1000
13C5 PFNA	Wellington Laboratories Code: MPFNA	$^{13}C_5$-Perfluorononanoic acid	50.0	200		1000
13C4 PFOS	Wellington Laboratories Code: MPFOS	$^{13}C_4$-Perfluorooctanesulfonic acid	47.8	200		956
13C2 PFDA	Wellington Laboratories Code: MPFDA	$^{13}C_2$-Perfluorodecanoic acid	50.0	200		1000
13C8 FOSA	Wellington Laboratories Code: M8FOSA-I	$^{13}C_8$-Perfluorooctane sulfonamide	50.0	200		1000
13C2 PFUdA	Wellington Laboratories Code: MPFUdA	$^{13}C_2$-Perfluoroundecanoic acid	50.0	200		1000
13C2 PFDoA	Wellington Laboratories Code: MPFDoA	$^{13}C_2$-Perfluorododecanoic acid	50.0	200		1000
13C2 PFTeDA	Wellington Laboratories Code: MPFTeDA	$^{13}C_2$-Perfluorotetradecanoic acid	50.0	200		1000
M2-6:2FTS	Wellington Laboratories Code: M2-6:FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-$^{13}C_2$]-octane sulfonate (6:2)	47.5	200		950
M2-8:2FTS	Wellington Laboratories Code: M2-8:FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-$^{13}C_2$]-decane sulfonate (8:2)	47.9	200		958
d3-NMeFOSAA	Wellington Laboratories Code: d3-M-MeFOSAA	N-methyl-d_3-perfluoro-1-octane sulfonamidoacetic acid	50.0	200		1000
d5-NEtFOSAA	Wellington Laboratories Code: d5-M-EtFOSAA	N-ethyl-d_5-perfluoro-1-octane sulfonamidoacetic acid	50.0	200		1000

Solvent: Methanol

PFAS Internal Standard Solution 5000 ng/mL

Parent Standard	Vendor	Component	Stock Standard Conc (µg/mL)	Volume Added (µL)	Final Volume (mL)	Final Conc (ng/mL)
13C2 PFOA	Wellington Laboratories Code: M2PFOA	$^{13}C_2$-Perfluorooctanoic acid	50.0	400	4	5000

Solvent: Methanol

PFAS-IDA-IS Routine Calibration Standards Level 1-Level 9

ICAL Level	Vol of PFAS LCS/Matrix Spike (µL)	Nominal Conc of PFAS (ng/mL)	Vol of PFAS-IDA Solution (µL)	Conc of IDA (ng/mL)	Vol of PFAS-IS Solution (µL)	Conc of IS (ng/mL)	Vol of Water (µL)	Vol of 80/20 MeOH/H2O (µL)	Final Vol (mL)
1	4	1.0	200	50	40	50	51	3745	4.0
2	2	2.0	50	50	10	50	13	935	1.0
3	16	5.0	160	50	32	50	44	2980	3.2
4	20	10.0	100	50	20	50	30	1850	2.0
5	72	20.0	180	50	36	50	63	3285	3.6

6	30	30.0	50	50	10	50	20	900	1.0
7	160	50.0	160	50	32	50	80	2800	3.2
8	120	100	60	50	12	50	45	975	1.2
9	240	200	60	50	12	50	75	825	1.2

The solvent is 80/20 Methanol/Water.

Appendix C: Equations

Initial Calibration Curve Evaluation:

The linear curve uses the following function:

Equation 1

$$y = bx + c$$

Where:

y = $\frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$
x = concentration
b = slope
c = intercept

The quadratic curve uses the following function:

Equation 2

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

The external standard method uses the following equation:

Equation 3

$$Response\ Factor = \frac{Peak\ \ Area}{Concentration\ of\ \ Solution\ (ng/mL)}$$

Equation 4

$$\text{Concentration, ng/mL} = \frac{y-c}{b}$$

Equation 5

$$\text{Concentration, ng/mL} = \frac{-b+\sqrt{b^2-4a(c-y)}}{2a}$$

Where:

y = $\frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$
x = concentration
a = curvature
b = slope
c = intercept

Water Sample Result Calculation:

Equation 6

$$\text{Concentration, ng/L} = \frac{C_{ex}V_t}{V_o}$$

Where:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
V_o = Volume of water extracted (L)

IDA Recovery Calculation:

Equation 8

$$\% \text{Recovery} = \frac{A_t Q_{is}}{A_{is} Q_t RRF_{IDA}} X100$$

Where ng/g = µg/kg and:

RF_{IDA} = Response Factor for IDA compound
A_t = Area response for IDA compound
A_{IS} = Area Response for IS compound
Q_{IS} = Amount of IS added
Q_t = Amount of IDA added

Calibration Factor (CF_x) =

$$\frac{\text{Peak area or height}_{(x)}}{\text{Standard concentration}_{(\mu g/L)}}$$

Mean Calibration Factor ($\overline{CF}$) =

$$\frac{\sum_{i=1}^{n} CF_i}{n}$$

where: n = number of calibration levels

Standard Deviation of the Calibration Factor (SD) =

$$\sqrt{\frac{\sum_{i=1}^{n}\left(CF_i - \overline{CF}\right)2}{n-1}}$$

where: n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Calibration Factor =

$$\frac{SD}{\overline{\overline{CF}}} \times 100\%$$

Percent Difference (%D) =

$$\frac{CF_v - \overline{CF}}{\overline{\overline{CF}}} \times 100\%$$

where: CF_v = Calibration Factor from the Continuing Calibration Verification (CCV)

Percent Drift = $\frac{\text{Calculated Concentration – Theoretical Concentration}}{\text{Theoretical Concentration}}$ x 100%

Percent Recovery (%R) = $\frac{C_s}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Field or QC Sample
C_n = Nominal Concentration of Spike Added

Percent Recovery (%R) for MS/MSD = $\frac{C_s - C_u}{C_n} \times 100\%$

where: C_s = Concentration of the Spiked Sample
C_u = Concentration of the Unspiked Sample
C_n = Nominal Concentration of Spike Added

Relative Percent Difference (%RPD) = $\frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100\%$

where: C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Sample Concentration

Extract

$C_{extract}$ (µg/L) = $\frac{\text{Peak Area (or Height)}}{\overline{\text{CF}}}$

Note: The concentrations of the 3-5 peaks chosen for quantificaton is calculated and the average is then taken for final calculation.

Title: Per- and Polyfluorinated Substances (PFAS) in Water, Soils, Sediments and Tissue

[Method 537 (Modified), Method PFAS by LCMSMS Compliant with QSM 5.1 Table B-15]

Approvals (Signature/Date):

	11/27/2018		11/27/2018
Robert Hrabak Technical Manager	Date	Joe Schairer Health & Safety Manager / Coordinator	Date
	11/30/2018		11/27/2018
Lisa Stafford Quality Assurance Manager	Date	Chris Williams Laboratory Manager	Date

Facility Distribution No. Uncontrolled **Distributed To:** Sacramento Bids Folder

1. SCOPE AND APPLICATION

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

Compound Name	Abbreviation	CAS #
Perfluoroalkylcarboxylic acids (PFCAs)		
Perfluoro-n-butanoic acid	PFBA	375-22-4
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3
Perfluoro-n-hexanoic acid	PFHxA	307-24-4
Perfluoro-n-heptanoic acid	PFHpA	375-85-9
Perfluoro-n-octanoic acid	PFOA	335-67-1
Perfluoro-n-nonanoic acid	PFNA	375-95-1
Perfluoro-n-decanoic acid	PFDA	335-76-2
Perfluoro-n-undecanoic acid	PFUdA (PFUnA)	2058-94-8
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8
Perfluoro-n-tetradecanoic acid	PFTeDA (PFTA)	376-06-7
Perfluoro-n-hexadecanoic acid (non-routine analyte)	PFHxDA	67905-19-5
Perfluoro-n-octadecanoic acid (non-routine analyte)	PFODA	16517-11-6
Perfluorinated sulfonic acids (PFSAs)		
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5
Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-1
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1
Perfluoro-nonanesulfonic acid	PFNS	8789-57-2
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3
Perfluoro-1-dodecansulfonic acid	PFDoS	79780-39-5
Perfluorinated sulfonamides (FOSA)		
Perfluoro-1-octanesulfonamide	FOSA	754-91-6
Perfluorinated sulfonamidoacetic acids (FOSAA)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid	EtFOSAA	2991-50-6
N-methylperfluoro-1-octanesulfonamidoacetic acid	MeFOSAA	2355-31-9
Fluorotelomer sulfonates (FTS)		
1H,1H,2H,2H-perfluorohexane sulfonate *(4:2)*	4:2 FTS	757124-72-4
1H,1H,2H,2H-perfluorooctane sulfonate *(6:2)*	6:2 FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonate *(8:2)*	8:2 FTS	39108-34-4
1H,1H,2H,2H-perfluorododecane sulfonate *(10:2)*	10:2 FTS	120226-60-0

Abbreviations in parenthesis are the abbreviations listed in Method 537, where they differ from the abbreviation used by the laboratory's LIMS.

1.2. Additional analytes supported by this method: The following analytes can be supported by this method under special request.

Compound Name	**Abbreviation**	**CAS #**
Fluorinated Replacement Chemicals		
Dona (Donic acid)	Dona	919005-14-4
Perfluoro(2-propoxypropanoic) acid	HFPO-DA or GenX	13252-13-6
F53B (reported as the summation of the following)	F53B	NA
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonate	F53B major	73606-19-6
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonate	F5B minor	83329-89-9

1.3. The working range of the method is listed below. The linear range can be extended by diluting the extracts.

Matrix	**Nominal Sample Size**	**Reporting Limit**	**Working Range**
Water	250 mL	2.0 ng/L – 20 ng/L	2.0 ng/L - 400 ng/L
Soil/Sediment	5 g	0.2 ug/kg – 2.0 ug/kg	0.2 ug/kg - 40 ug/kg
Tissue	1 g	1.0 ug/kg – 10 ug/kg	1.0 ug/kg – 200 ug/kg

1.4. The procedure for the analysis of water samples via in line solid phase extraction (SPE) for a subset of the list in Section 1.1 using liquid chromatography / tandem mass spectrometry (LC/MS/MS) on a SCIEX 5500 is described in Attachment 1 of this SOP.

1.5. This procedure also includes direction for preparing and analyzing samples to determine "Total Oxidizable Precursors", which may assist in improving understanding of potential PFAS environmental risk.

1.6. When undertaking projects for the Department of Defense (DoD) and/or the Department of Energy (DOE) the relevant criteria in QA Policy WS-PQA-021, "Federal Program Requirements" must be checked and incorporated.

2. SUMMARY OF METHOD

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

2.2. Soil/sediment/tissue samples are extracted with a KOH/methanol solution using an orbital shaker for 3 hours followed by sonication for 12 hours. The mixture is centrifuged and the solvent filtered.

2.3. The final 80:20 methanol:water extracts are analyzed by LC/MS/MS. PFAS are separated from other components on a C18 column with a solvent gradient program using 20 mM ammonium acetate/water and methanol. The mass spectrometer detector is operated in the electrospray (ESI) negative ion mode for the analysis of PFAS.

2.4. An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDA) consist of carbon-13 labeled analogs, oxygen-18 labeled analogs, or deuterated analogs of the compounds of interest, and they are spiked into the samples at the time of extraction. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related interferences to the same extent as the compounds of concern. Compounds that do not have an identically labeled analog are quantitated by the IDA method using a closely related labeled analog.

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

2.6. Samples for the “Total Oxidizable Precursor” assay (TOP) are analyzed in two phases – an aliquot is prepared and analyzed as a normal sample, and a second aliquot is subjected to oxidation with potassium persulfate and sodium hydroxide prior to solid phase extraction and analysis. The total perfluorocarboxylic acid value is determined for each aliquot, and the difference calculated.

3. DEFINITIONS

3.1. PFCAs: Perfluorocarboxylic acids

3.2. PFSAs: Perfluorinated sulfonic acids

3.3. FOSA: Perfluorinated sulfonamide

3.4. PFOA: Perfluorooctanoic acid

3.5. PFOS: Perfluorooctane sulfonic acid

3.6. MPFOA: Perfluoro-n-[1,2,3,4-13C4]octanoic acid. Carbon-13 labeled PFOA

3.7. MPFOS: Perfluoro-1-[1,2,3,4-13C4]octanesulfonic acid. Carbon-13 labeled PFOS

3.8. PTFE: Polytetrafluoroethylene (e.g., Teflon®)

3.9. SPE: Solid phase extraction

3.10. PP: Polypropylene

3.11. PE: Polyethylene

3.12. HDPE: High density polyethylene

3.13. AFFF: Aqueous Film Forming Foam

3.14. IDA: Isotope dilution analyte

3.15. Further definitions of terms used in this SOP may be found in the glossary of the Laboratory Quality Assurance Manual (QAM).

4. INTERFERENCES

4.1. PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean. These items are listed below in Section 6.

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

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

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

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

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

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

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

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

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

4.7. Per the Certificate of Analysis for labeled perfluorohexadecanoic acid ($13C_2$-PFHxDA) produced by Wellington Laboratories, the stock standard contains roughly 0.3% of native perfluorohexadecanoic acid. This equates to roughly 0.30 ng/L or 0.015 ug/kg of perfluorohexadecanoic acid expected in all samples and blanks.

5. SAFETY

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

5.1. Specific Safety Concerns

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

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

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

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

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

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

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

5.2. Primary Materials Used

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

Material[(1)]	**Hazards**	**Exposure Limit**[(2)]	**Signs and Symptoms of Exposure**
Acetic Acid (3-2-1)	Corrosive Poison Flammable	10 ppm-TWA 15 ppm-STEL	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.

Material[1]	Hazards	Exposure Limit[2]	Signs and Symptoms of Exposure
Ammonium Hydroxide (3-0-0)	Corrosive Poison	50 ppm-TWA	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal.
Hexane (2-3-0)	Flammable Irritant	500 ppm-TWA	Inhalation of vapors irritates the respiratory tract. Overexposure may cause lightheadedness, nausea, headache, and blurred vision. Vapors may cause irritation to the skin and eyes.
Hydrochloric Acid (3-0-1)	Corrosive Poison	5 ppm (Ceiling)	Can cause pain and severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause deep ulcerations to skin, permanent eye damage, circulatory failure and swallowing may be fatal.
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm (TWA)	A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Potassium Hydroxide (3-0-1)	Corrosive Poison		Severe irritant. Can cause severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause severe scarring of tissue, blindness, and may be fatal if swallowed.
Potassium Persulfate (2-0-1-OX)	Oxidizer	None	Causes irritation to the respiratory tract. Symptoms may include coughing, shortness of breath. Causes irritation to skin and eyes. Symptoms include redness, itching, and pain. May cause dermatitis, burns, and moderate skin necrosis.
Sodium Hydroxide (3-0-1)	Corrosive Poison	2 mg/cm^3 (Ceiling)	Severe irritant. Can cause severe burns upon inhalation, ingestion, eye or skin contact. Exposure to concentrated solutions may cause severe scarring of tissue, blindness, and may be fatal if swallowed.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6. EQUIPMENT AND SUPPLIES

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

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 125 mL HDPE bottles with HDPE screw caps.

6.4. 250 mL HDPE bottles with HDPE screw caps.

6.5. Analytical balance capable of accurately weighing to the nearest 0.0001g, and checked for accuracy each day it is used in accordance with WS-QA-0041.

6.6. Extract concentrator or nitrogen manifold with water bath heating to 50-55°C.

6.7. Syringe filter, Millipore Millex-HV 0.45 um, or equivalent. Do not use PTFE type filters.

6.8. 300 µL autosampler vials, polypropylene, with polypropylene screw caps, Waters PN 1860004112, or equivalent.

6.9. SPE columns

6.9.1. Phenomenex Strata SPE C18, 6 mL, 500 mg, part number 8B-S002-HCH, Waters SepPak C18, 1 to 10g, or equivalent.

6.9.2. Waters Oasis WAX 150 mg/6 cc (PN 186002493) for the cleanup of solids.

6.9.3. Waters Oasis WAX 500 mg/6 cc (PN 186004647) for extraction of PFAS from aqueous sample.

6.9.4. Phenomenex Gemini 3 µm C18 110Å, 50 X 2 mm, Part No. 00B-4439-B0.

6.9.5. Phenomenex Luna 5 µm C18(2) 100Å, 30 X 3 mm, Part No. 00A-4252-Y0.

6.9.6. Penomenex Gemini 3 µm C18 110A, 50 X 3mm, Part No. 00B-4439-Y0.

6.10. Graphitized carbon (Envi-Carb™ or equivalent).

6.11. Vacuum manifold for Solid Phase Extraction (SPE).

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

6.13. Water bath: Heated with concentric ring cover capable of temperature control (±5°C) up to 95°C. The bath must be used in a fume hood.

6.14. Plastic tub for an ice bath, AKRO-N.S.T. part No. 35-180 or equivalent.

6.15. pH indicator paper, wide range.

6.16. Bottle rotating apparatus for soil extractions.

6.17. Glass fiber filter, Whatman GF/F, catalog number 1825 090 or equivalent.

6.18. Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS) – Either of the instruments described below, or equivalent, may be used for this method. Both HPLC are equipped with a refrigerated autosampler, an injection valve, and a pump capable of variable flow rate. The use of a column heater is required to maintain a stable temperature throughout the analytical run. Data is processed using Chrom Peak Review, version 2.1 or equivalent.

6.18.1. SCIEX LC/MS/MS

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

6.18.1.1. Shimadzu CTO-20AC HPLC equipped with 3 LC-20AD pumps and one DGU-20 degassing unit or equivalent.

6.18.1.2. Phenomenex Gemini C_{18} 3 um, 3.0 mm x 100 mm, Part No. 00D-4439-Y0, or equivalent.

6.18.1.3. PFAS Isolator column, Phenomenex Luna C_{18} 5 um, 50 mm x 4.6 mm, part no. 00B-4252-E0 or equivalent. This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

6.18.2. Waters LC/MS/MS

This consists of a Waters Acquity UPLC system interfaced with a Waters Quattro Premier tandem mass spectrometer. The instrument control and data acquisition software is MassLynx version 4.1, or equivalent.

6.18.2.1. Analytical column: Waters Acquity UPLC BEH C18 1.7 um, 3.0 mm x 150 mm, Part No. 186004690

6.18.2.2. PFAS Isolator column, Waters Acquity UPLC BEH Shield RP-18, 1.7 um, 2.1 mm x 50 mm, PN 186004476, or equivalent. This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

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

HPLC/MS/MS Preventative Maintenance	
As Needed:	**Daily (When in use)**
Change pump seals. Change in-line filters in autosampler (HPLC). Check/replace in-line frit if excessive pressure or poor performance. Replace column if no change following in-line frit change. Clean corona needle. Replace sample inlet tube in APCI (10.1 cm). Replace fused silica tube in ESI interface. Clean lenses. Clean skimmer. Ballast rough pump 30 minutes. Create all eluents in Reagent module, label eluent containers with TALS label and place 2nd label into maintenance log when put into use.	Check solvent reservoirs for sufficient level of solvent. Verify that pump is primed, operating pulse free. Check needle wash reservoir for sufficient solvent. Verify capillary heater temperature functioning. Verify vaporizer heater temperature. Verify rough pump oil levels. Verify turbo-pump functioning. Verify nitrogen pressure for auxiliary and sheath gasses. Verify that corona and multiplier are functioning.
Semi-Annually	**Annually**
Replace rough-pump oil (4-6 months). Replace oil mist and odor elements. Replace activated alumina filter if applicable	Vacuum system components including fans and fan covers. Clean/replace fan filters, if applicable.

7. REAGENTS AND STANDARDS

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

7.1.1. Acetic acid, glacial

7.1.2. Ammonium acetate (20 mM in water): Prepared by weighing 1.509g of ammonium acetate and dissolving in 1L of water. The resultant solution is filtered through a 0.22um filter before use. This solution has volatile components, thus it should be replaced every 7 days or sooner.

7.1.3. Ammonium hydroxide (NH4OH), 0.3% in methanol: Prepared by diluting 12mL of ammonium hydroxide into 4L of methanol.

7.1.4. Hexane

7.1.5. Hydrochloric acid (HCl), 2.0 M solution in water

7.1.6. Hydrochloric acid (HCl), concentrated, reagent grade

7.1.7. Methanol

7.1.8. Potassium hydroxide (KOH), 0.4% in methanol: Prepared by weighing 16g of potassium hydroxide and dissolving in 4L of methanol.

7.1.9. Potassium persulfate, reagent grade

7.1.10. Ottawa Sand

7.1.11. Sodium hydroxide (NaOH), 0.1N, in water: Prepared by diluting 400mL of 1N NaOH into 3.6L of water for a total volume of 4L.

7.1.12. Sodium hydroxide (NaOH), 10N, reagent grade

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

7.2. Standards

7.2.1. PFAS are purchased as high purity solids (96% or greater) or as certified solutions. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor.

7.2.1.1. Per the Certificate of Analysis for labeled perfluorohexadecanoic acid ($13C_2$-PFHxDA) produced by Wellington Laboratories, the stock standard contains roughly 0.3% of native perfluorohexadecanoic acid. This equates to roughly 0.30 ng/L or 0.015 ug/kg of perfluorohexadecanoic acid expected in all samples and blanks.

7.2.2. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 4 ± 2°C. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

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

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

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

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

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

7.3. Calibration Standards

The calibration stock solution is prepared by diluting the appropriate amounts of PFCA and PFSA stock solutions in 80% methanol/water. The calibration stock solution is diluted with methanol to produce initial calibration standards. These are the normal calibration levels used. A different range can be used if needed to achieve lower reporting limits or a higher linear range.

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

Compound	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**
Perfluoroalkylcarboxylic acids (PFCAs)							
PFBA	0.5	1.0	5.0	20	50	200	400
PFPeA	0.5	1.0	5.0	20	50	200	400
PFHxA	0.5	1.0	5.0	20	50	200	400
PFHpA	0.5	1.0	5.0	20	50	200	400
PFOA	0.5	1.0	5.0	20	50	200	400
PFNA	0.5	1.0	5.0	20	50	200	400
PFDA	0.5	1.0	5.0	20	50	200	400
PFUdA	0.5	1.0	5.0	20	50	200	400
PFDoA	0.5	1.0	5.0	20	50	200	400
PFTrDA	0.5	1.0	5.0	20	50	200	400
PFTeDA	0.5	1.0	5.0	20	50	200	400
PFHxDA	0.5	1.0	5.0	20	50	200	400
PFODA	0.5	1.0	5.0	20	50	200	400
Perfluorinated sulfonic acids (PFSAs)							
PFBS	0.5	1.0	5.0	20	50	200	400
PFPeS	0.5	1.0	5.0	20	50	200	400
PFHxS *	0.5	1.0	5.0	20	50	200	400
PFHpS	0.5	1.0	5.0	20	50	200	400
PFOS *	0.5	1.0	5.0	20	50	200	400
PFNS	0.5	1.0	5.0	20	50	200	400
PFDS	0.5	1.0	5.0	20	50	200	400
PFDoS	0.5	1.0	5.0	20	50	200	400
Perfluorinated sulfonamides (FOSA)							

Compound	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**
FOSA	0.5	1.0	5.0	20	50	200	400
Perfluorinated sulfonamidoacetic acids (FOSAA)							
EtFOSAA	0.5	1.0	5.0	20	50	200	400
MeFOSAA	0.5	1.0	5.0	20	50	200	400
Fluorotelomer sulfonates (FTS)							
4:2 FTS	0.5	1.0	2.0	20	50	200	400
6:2 FTS	0.5	1.0	5.0	20	50	200	400
8:2 FTS	0.5	1.0	5.0	20	50	200	400
10:2 FTS	0.5	1.0	5.0	20	50	200	400
Labeled Isotope Dilution Analytes (IDA)							
13C4-PFBA	50	50	50	50	50	50	50
13C5-PFPeA	50	50	50	50	50	50	50
13C2-PFHxA	50	50	50	50	50	50	50
13C4-PFHpA	50	50	50	50	50	50	50
13C4-PFOA	50	50	50	50	50	50	50
13C5-PFNA	50	50	50	50	50	50	50
13C2-PFDA	50	50	50	50	50	50	50
13C2-PFUdA	50	50	50	50	50	50	50
13C2-PFDoA	50	50	50	50	50	50	50
18O2-PFHxS	50	50	50	50	50	50	50
13C4-PFOS	50	50	50	50	50	50	50
13C3-PFBS	50	50	50	50	50	50	50
13C2-PFTeDA	50	50	50	50	50	50	50
13C2-PFHxDA	50	50	50	50	50	50	50
13C8-FOSA	50	50	50	50	50	50	50
d5-EtFOSAA	50	50	50	50	50	50	50
d3-MeFOSAA	50	50	50	50	50	50	50
M2-4:2FTS ǂ	50	50	50	50	50	50	50
M2-6:2FTS	50	50	50	50	50	50	50
M2-8:2FTS	50	50	50	50	50	50	50
Internal Standard (IS)							
13C2-PFOA	50	50	50	50	50	50	50

* Both branched and linear isomers are used.

ǂ - This compound is used as a reverse surrogate for the TOP analysis.

Note: Sample extracts are in 80% MeOH/H_2O.

Compound	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**
Fluorinated Replacement Chemicals							
HFPO-DA	0.5	1.0	5.0	20	50	200	400
9Cl-PF3ONS	0.5	1.0	5.0	20	50	200	400

Compound	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**
Fluorinated Replacement Chemicals							
(F53B major)							
11Cl-PF3OUdS (F53B minor)	0.5	1.0	5.0	20	50	200	400
Dona	0.5	1.0	5.0	20	50	200	400
Labeled Isotope Dilution Analytes							
13C3-HFPO-DA	0.5	1.0	5.0	20	50	200	400

Note: Sample extracts are in 80% MeOH/H_2O.

***Note**: The above calibration limits are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program. The concentration of the calibration solutions for non-concentrated extracts is 1/20th the levels indicated above.*

7.4.1. A technical (qualitative) grade PFOA standard which contains both linear and branched isomers is used as a retention time (RT) marker. This is used to integrate the total response for both linear and branched isomers of PFOA in environmental samples while relying on the initial calibration with the linear isomer quantitative standard This technical (qualitative) grade PFOA standard is analyzed initially, after an initial calibration when a new column is installed or when significant changes are made to the HPLC parameters.

7.5. Initial Calibration Verification Standard (ICV)

A second source solution for PFAS is purchased from the same vendor; the PFC-MXB contains most of the target analytes in this mixture and is used as an ICV. A few compounds are not available in this mixture, may not be available as another lot, and are not available from another vendor. For these analytes only, a second analyst may prepare a second source standard from the same source as the ICAL to produce an ICV. The recommended concentration of the ICV standard should be in the mid-range of the calibration curve. The concentration may be adjusted if the initial calibration levels are changed or altered. The IDA and IS are added at a fixed concentration of 50 ng/mL.

7.6. LCS/Matrix PFC Spike Solution, 20 ng/mL

The PFC spike solution is prepared by diluting all PFAS to produce a solution containing each PFAS at a concentration of 20 ng/mL in methanol.

7.7. PFC Isotope Dilution Analyte Solution, 50 ng/mL

The PFC-IDA solution is prepared by diluting all labeled PFAS to produce a solution containing each compound at a concentration of 50 ng/mL in methanol.

7.8. Reverse Surrogate Solution, 1000 ng/mL

The reverse surrogate solution is prepared by diluting M2-4:2 FTS to produce a solution containing this compound at a concentration of 1000 ng/mL in methanol. This is added to all samples for the TOP assay to monitor the efficiency of the oxidation process.

7.9. Internal Standard Solution, 250 ng/mL

The internal standard solution is prepared by diluting 13C2-PFOA to produce a solution containing this compound at a concentration of 250 ng/mL in methanol. This is added to all extracts prior to analysis. The internal standard solution used for the non-concentrated extracts is at a concentration of 50 ng/mL.

8. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

8.1. Water samples are collected in pre-cleaned 250 mL HDPE containers. Soil samples are collected in pre-cleaned 8 oz. HDPE containers. Other containers may also be suitable. Samples are chilled to 0 - 6°C for shipment to the laboratory.

8.1.1. Water samples collected from a known chlorinated source should be preserved with Trizma.

8.2. Samples are logged in following normal laboratory procedures and are stored under refrigeration at 0 - 6°C. Water samples must be extracted within 14 days of collection. Soil samples must also be extracted within 14 days of collection. Tissue samples must be extracted within 1 year of collection if stored at -20°C. Extracts must be refrigerated at 0 - 6°C, and analyzed within 40 days from extraction.

***Note**: As of this writing, Method 537 provides for a 14 day holding time for water samples preserved with Trizma buffer. The scientific literature indicates that perfluorinated substances are highly persistent in the environment. TestAmerica Sacramento has conducted time stability studies that support a 14 day holding time for aqueous samples with and without Trizma preservation. TestAmerica Denver has conducted stability studies indicating that medium- and low-level solutions of PFOA are stable for at least three months in polystyrene and polypropylene plastics at 0-6°C. The 14/40 day holding times given above are based on the stability study and general EPA convention for the holding time of extractable organic compounds in water and soil.*

9. QUALITY CONTROL

9.1. Initial Demonstration of Capability (IDOC)

The initial demonstration and method detection limit (MDL) studies described in Section 13 must be acceptable before analysis of samples may begin.

9.2. Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. Refer to the QC program document (WS-PQA-003) for further details of the batch definition.

9.2.1. The quality control batch is a set of up to 20 samples of the same matrix processed using the same procedure and reagents within the same time period. The quality control batch must contain a matrix spike/matrix spike duplicate (MS/MSD), a laboratory control sample (LCS) and a method blank. Laboratory generated QC samples (Blank, LCS, MS/MSD) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, the MS/MSD may be replaced with a matrix spike and sample duplicate. If insufficient sample is available for an MS/MSD, an LCSD may be substituted if batch precision is required by the program or client. In the event that multiple MS/MSDs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

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

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

9.3.2. The method blank must not contain any analyte at or above the reporting limit, or at or above 10% of the measured concentration of that analyte in the associated samples, whichever is higher.

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

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

9.3.5. Refer to WS-PQA-003 for further details of the corrective actions.

9.3.6. Projects performed under the auspices of the DOD/DOE must meet QSM specific criteria for method blanks. Results are acceptable if the blank contamination is less than ½ of the reporting limit/LOQ for each analyte, or less than 1/10 of the regulatory limit, or less than 1/10 of the sample result for the same analyte, whichever is greater. If the method blank does not meet the acceptance criteria, the source of contamination must be investigated and measures taken to correct, minimize or eliminate the problem. Reprepare and reanalyze all field and QC samples associated with the contaminated method blank.

9.4. A laboratory control sample (LCS) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LCS is deemed unacceptable. See WS-PQA-0003 for specific acceptance criteria. The control limits for the LCS are stored in TALS.

9.5. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) pair must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Spiked analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, and then implemented when recoveries of any spiked analyte are outside of the control limits provided by TALS or by the client.

9.6. A duplicate control sample (LCSD or DCS) may be added when insufficient sample volume is provided to process an MS/MSD pair, or is requested by the client. The LCSD is evaluated in the same manner as the LCS. See WS-PQA-003 for specific acceptance criteria.

9.7. Initial calibration verification (ICV) –A second source standard is analyzed with the initial calibration curve. The concentration should be at the mid range of the curve.

Corrective actions for the ICV include:

- Rerun the ICV.
- Remake or acquire a new ICV.
- Evaluate the instrument conditions.
- Evaluate the initial calibration standards.

- Rerun the initial calibration.

9.8. Isotope Dilution Analytes

9.8.1. The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 11. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

9.8.2. IDA recoveries are flagged if they are outside of the acceptance limits (25–150%). Quantitation by isotope dilution generally precludes any adverse effect on data quality due to IDA recoveries being outside of the acceptance limits as long as the signal-to-nose ratio is greater than 10:1.

9.8.2.1. Evaluate data quality for usability, flag and submit a non-conformance memo for any analytes outside of the recovery criteria, and report if data is deemed not adversely effected.

9.8.2.2. Re-extraction of samples should be performed if the signal-to-noise for any IDA is less than 10:1 or if the IDA recoveries fall below 10%.

9.8.2.2.1. Re-extraction may be necessary under other circumstances when data quality has been determined to be adversely affected.

9.8.2.3. Projects performed under the auspices of the DoD/DOE must meet QSM 5.1 specific criteria for IDA recoveries which are 50-150%. If QC or field samples do not meet these criteria then re-extraction is required.

9.9. Internal Standard

9.9.1. The Internal Standard (IS) is added to each field and QC samples prior to analysis. The CCV IS response (peak area) must not deviate by more than 50% from the average response (peak area) of the initial calibration.

9.9.2. Sample IS response (peak area) must be within ±50% of the response (peak area) in the most recent CCV.

9.9.3. If the IS does not meet criteria, re-analyze the extract. If the IS meets criteria in the second analysis, report that analysis. If the IS does not meet criteria in the second analysis, report the first analysis with narration.

10. CALIBRATION

10.1. For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations, refer to SOP CA-Q-P-003 “Calibration Curves and Selection of Calibration Points”.

10.2. Routine instrument operating conditions are listed in the table in Section 11.18.

10.3. Instrument Tuning

Instrument tuning is done initially when the method is first developed and thereafter as needed to maintain the sensitivity and selectivity of the method. Tuning is done by infusing each individual compound (native and IDA) into the mobile phase using a tee fitting at a point just before the entrance to the electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and calibrated if necessary. The mass assignments must be within ± 0.5 amu of the values shown in the table in Section 11.18.

10.3.1. Once the optimal mass assignments (within ±0.5 amu of true) are made immediately following the initial tune, the lowest level standard from the initial calibration curve is assessed to ensure that a signal to noise ratio greater than 10 to 1 (S/N > 10:1) is achieved for each PFAS analyte. The first level standard from the initial calibration curve is used to evaluate the tune stability on an ongoing basis. The instrument mass windows are set initially at ± 0.5 amu of the true value; therefore, continued detection of the analyte transition with S/N > 10:1 serves as verification that the assigned mass remains within ± 0.5 amu of the true value, which meets the DoD/DOE QSM tune criterion. For QSM work, the instrument sensitivity check (section 10.12.4) is also evaluated to ensure that the signal to noise criteria is met.

10.4. A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include, but are not limited to, new columns or pump seals. A new calibration is not required after minor maintenance.

10.5. With the exception of the circumstances delineated in policy CA-Q-P-003, it is not acceptable to remove points from a calibration curve. In any event, at least five points must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points.

10.6. A fixed injection volume is used for quantitation purposes and is to be the same for both the sample and standards.

10.7. All units used in the calculations must be consistently uniform, such as concentration in ng/mL.

10.8. Initial Calibration

10.8.1. A number of analytical standards of different analyte concentrations are used to generate the curve. Each standard is injected once to obtain the peak response for each analyte at each concentration. These standards define the working range of the analysis.

10.8.1.1. A minimum of five analytical standards is used when using average response factor and/or linear calibration fits.

10.8.1.2. A minimum of six analytical standards is used when a quadratic fit is used to generate the curve.

10.8.2. Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used for the analyte if the response is non-linear.

10.8.2.1. For average response factor (RFa), the relative standard deviation (RSD) for all compounds quantitated against an identically labeled analog must be < 35% for the curve to be valid.

10.8.2.2. For average response factor (RFa), the relative standard deviation (RSD) for all compounds quantitated against a closely related labeled analog IDA must be < 50% for the curve to be valid.

10.8.2.3. For linear fit, the intercept of the line must be less than ½ the reporting limit, and the coefficient of determination (r2) must be greater than or equal to 0.990 for the curve to be considered valid (or the correlation coefficient (r) > 0.995).

10.8.2.4. The Internal Standard (IS) response (peak area) must not deviate by more than 50% from the average response (peak area) of the initial calibration.

10.8.2.5. Projects performed under the auspices of the DoD/DOE must meet QSM 5.1 specific criteria for initial calibration: The %RSD of the RFS for all analytes must be <20%. Linear or non-linear calibrations must have r^2>0.99 for each analyte. Analytes must be within 70-130% of their true value for each calibration standard.

10.9. Calibration Curve Fits

10.9.1. Linear regression or quadratic curves may be used to fit the data to a calibration function. Detailed descriptions and formulas for each fitting type can be found in SOP CA-Q-P-003, “Calibration Curves and Selection of Calibration Points”.

10.9.2. The linear curve uses the following function:

Equation 1

$$y = bx + c$$

Where:

$$y = \frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$$

x = concentration
b = slope
c = intercept

10.9.3. The quadratic curve uses the following function:

Equation 2

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

10.9.4. Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

- Response must increase with increasing concentration.
- The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.
- There should be no carryover at or above 1/2 MRL after a high CAL standard.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

10.9.5. Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration or 1/x weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.10. Initial Calibration Blank (ICB)

10.10.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of 80:20 methanol:water blank containing both IDA and IS.

10.10.2. The result for the calibration blank must be less than the reporting limit.

10.10.3. If the ICB is greater than the reporting limit then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.10.4. Projects performed under the auspices of the DoD/DOE must meet QSM 5.1 specific criteria for instrument blanks. One is required immediately following the highest standard analyzed and *daily prior to sample analysis*. The instrument blank must be < ½ the LOQ.

10.11. Initial Calibration Verification (ICV)

10.11.1. Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

10.11.2. The recovery for the ICV must meet the appropriate following criteria:

10.11.2.1. The native analyte must be within or equal to 60-140% for all native analytes quantitated against an identically labeled analog IDA.

10.11.2.2. The native analyte must be within or equal to 50-150% for all native analytes quantitated against a closely related labeled analog IDA.

10.11.2.3. The IDA must be within or equal to 50-150%.

10.11.3. Projects performed under the auspices of the DoD/DOE must meet QSM 5.1 specific criteria for the ICV. Analyte concentrations must be within ±30% of their true values for all analytes, IDA and target.

10.11.4. See Section 9.7 for corrective actions in the event that the ICV does not meet the criteria above.

10.12. Continuing Calibration Verification (CCV)

Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are usually at the mid-level range of the curve and should vary throughout the run from low level (LOQ/RL) to mid level. The curve and ICV do not need to be run every day. To start an analytical run a CCV can be analyzed and if it meets acceptance criteria a run can be started. In addition, the low standard in the curve must be analyzed and must be within ± 50% of the expected value.

10.12.1. The recovery for the CCV standards must be equal to or within 60-140% for all natives quantitated against an identically labeled analog and equal to or within 50% to 150% for all natives quantitated against a closely related labeled analog. The recovery for the IDA must be within or equal to 50-150%.

10.12.2. The Internal Standard (IS) response (peak area) must be within ± 50% from the response (peak area) from the midpoint of the initial calibration.

10.12.2.1. Sample IS response (peak area) must be within ± 50% of the response (peak area) in the most recent CCV.

10.12.3. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

10.12.4. Projects performed under the auspices of the DoD/DOE must meet QSM 5.1 specific criteria for CCV. All analyte concentrations must be within ± 30% of their true value. Additionally, prior to analysis and at least once every 12 hours an instrument sensitivity check (ISC/CCVL) must be analyzed. The analyte concentrations must be at LOQ and the concentrations must be within ± 30% of their true value. This can be used as a CCV.

11. PROCEDURE

11.1. One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using an Non-Conformance Memo (NCM). The NCM process is described in more detail in SOP WS-QA-0023. The NCM shall be filed in the project file and addressed in the case narrative.

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

11.2. Water Sample Preparation

11.2.1. Visually inspect samples for the presence of settled and/or suspended sediment/particulates. If present or if the sample is biphasic add IDA prior to any sample decanting or centrifugation. If the sample requires decanting or centrifugation contact the client for guidance prior to such action.

Decanting or filtering of the sample can lead to a low bias.

11.2.2. If authorized by the client to filter the sample, filter the water sample through a glass fiber filter (Whatman GF/F Cat No 1825 090 or equivalent). Gravity or vacuum can be used to pass the sample through the filter. Prepare a filtration blank with any samples requiring filtration. File an NCM noting the need for filtration.

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

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

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

11.2.5. Prepare two 250 mL aliquots of HPLC-grade water for the method blank and LCS.

11.2.6. Spike the LCS and MS/MSD (if requested) with 0.5 mL of the LCS/Matrix PFC Spike solution (Section 7.6). This will result in a sample concentration of 40 ng/L.

11.2.7. Add 0.5 mL of the IDA PFC solution (Section 7.7) into each sample and QC sample, for a fixed concentration of 50 ng/mL in the final sample vial.

11.3. Solid Phase Extraction (SPE) of Aqueous Samples

The automated Zymark Auto-Trace Workstation can be used as long as the program follows these conditions and passes the background check.

11.3.1. Condition the SPE cartridges (Waters WAX, 500 mg/6 cc) by passing the following without drying the column.

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

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

11.3.2. Wash with 5.0 mL of 0.3% NH_4OH/methanol.

11.3.3. Wash with 5.0 mL of 0.1N NaOH/water. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.3.4. Appropriately label the columns and add the reservoir to the column.

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

11.3.6. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 1 mL of water.

11.3.7. After the sample and water rinse have completely passed through the cartridge, allow the column to dry well with vacuum for 15 minutes.

11.4. SPE Column Wash of Aqueous Samples with Hexane

11.4.1. Load the first 5 mL of hexane to soak for five minutes and then elute to waste.

11.4.2. Load the second 5 mL of hexane and elute to waste (without a soaking period).

11.4.3. Allow the column to dry with vacuum for 5 to 10 minutes. Columns must be dried before continuing.

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

11.5.1. Rinse sample bottles with 5 mL of 0.3% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Allow the solution to soak for 5 minutes and then elute into the 15 mL collection tube.

11.5.2. Repeat sample bottle to column reservoir rinse and cartridge elution with a second 5 mL aliquot of 0.3% NH_4OH/methanol. The total collection should be approximately 10 mL.

11.5.3. **Note: If the extracts will not be concentrated elute extract with a total of 8 mL of 0.3% NH_4OH/methanol.**

11.5.4. Proceed to Section 11.15.2 (Graphitized Carbon Cleanup) as needed. This required for all DoD/DOE extracts.

11.6. Extract Concentration for Aqueous Extracts (Note, if the extract will not be concentrated, proceed to Section 11.7.)

11.6.1. Prior to concentrating each sample, add 100 uL of water.

11.6.2. Concentrate each sample under a gentle stream of nitrogen until the methanol is evaporated and the 100 uL of water remains.

11.6.2.1. This blow down must take a minimum of 3.5 hours.

11.6.2.2. Extracts can not remain in the water bath longer than 5 minutes once concentrated.

11.6.3. Add 300 uL of methanol and mix the contents well using a vortex mixer.

11.6.4. Add 100 uL of Internal Standard (IS) 250 ng/mL concentration solution to each extract and vortex to mix.

11.6.5. This will create an extract with a final solvent composition of 80:20 methanol:water.

11.6.6. Transfer a portion of the extract to a 300 uL polypropylene autosampler vial (7 drop-wise or approximately ½ filled is sufficient). Archive the rest of the extracts for re-injection and dilution.

11.6.7. Seal the vial with a polypropylene screw cap. Note: Teflon lined caps can not be used due to detection of low level concentration of PFAS.

11.7. Final volume for non-concentrated extract

11.7.1. If the extract does not undergo concentration add 0.5 mL of IS 50 ng/mL concentration and 2 mL of water to the extract. This will create an extract with a final solvent composition of 80:20 methanol:water.

11.7.1.1. Seal the test tube tightly. Invert container several times and then vortex. Allow extract to settle for 10 minutes prior to moving to the next step.

11.7.2. Transfer a portion of the extract to a 300 uL polypropylene autosampler vial (7 drop-wise or approximately ½ filled is sufficient). Archive the rest of the extracts for re-injection and dilution.

11.7.3. Seal the vial with a polypropylene screw cap. Note: Teflon lined caps cannot be used due to detection of low level concentration of PFAS.

11.8. Soil, Sediment and Tissue Sample Preparation and Extraction

11.8.1. Visually inspect soil samples for homogeneity.

11.8.1.1. Projects performed under the auspices of the DoD/DOE must have the entire sample homogenized prior to subsampling in accordance with QSM 5.1 criteria (see SOP WS-QA-0018).

11.8.2. Weigh a representative 5 g aliquot of soil, sediment or 1 g of tissue sample into a 50 mL HDPE wide-mouth bottle. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

11.8.3. For the method blank and LCS matrix, use 5 g each of Ottawa sand or 0.1 g of oil.

11.8.4. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix PFC Spike solution (Section 7.6). This will result in a sample concentration of 4.0 ng/g.

11.8.4.1. Spike non-concentrated samples at 0.5 mL of LCS/Matrix PFC Spike Solution.

11.8.5. Add 1.0 mL of the IDA PFC solution (Section 7.7) into each sample and QC sample, for a fixed concentration of 50 ng/mL in the final sample vial.

11.8.5.1. Spike non-concentrated samples at 0.5 mL of IDA PFC Solution.

11.8.6. Cap the bottles and allow the spike to settle into the sample matrix. Gently shake the bottles to mix the spike into the matrix.

11.8.7. Add 20 mL of 0.4% KOH/methanol to each sample.

11.8.8. Shake each sample on an orbital shaker at room temperature for 3 hours.

11.8.9. Following the shaking, extract the samples in an ultrasonic water bath for an additional 12 hours.

11.8.10. After the completion of extraction, centrifuge each sample at 3500 rpm for 15 minutes.

11.8.11. Collect and decant the KOH/methanol extract to a new 50 mL centrifuge tube.

11.8.12. Add another 2 mL of 0.4% KOH/methanol solution to the residue, briefly shake to mix and centrifuge at 3500 rpm for 15 minutes.

11.8.13. Combine the rinsate to the first corresponding tubes.

11.8.14. To the final KOH/methanol extract, add 2 mL of water to each.

11.8.15. Concentrate the KOH/methanol/water extract under nitrogen to less than 2 mL, and dilute with water to 15 mL final volume.

11.8.16. Acidify with 80 uL of glacial acetic acid, and mix the contents well with vortex mixer. Check the pH to ensure pH is between 6 to 8.

11.8.17. Centrifuge at 3500 rpm for 15 minutes.

11.9. Solid Extract Cleanup by SPE

Set up WAX 150 mg/6 cc SPE columns for sample cleanup using vacuum manifold.

11.9.1. Condition the SPE cartridges by passing the following without drying the column.

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

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

11.9.2. Wash with 5.0 mL of 0.3% NH_4OH/methanol.

11.9.3. Wash with 10 mL of 0.1N NaOH/water. Close valve when ~ 500uL remains on top of column to keep column wet. *After this step, the columns cannot go dry until the completion of loading and rinsing samples.*

11.9.4. Add extracts to the columns and with vacuum, pull the entire extracts through the cartridge at rate of approximately 3 to 5 drops per second.

11.9.5. Rinse the sample tube with 5 mL of water and add to the SPE column.

11.9.6. Dry the columns with vacuum for 15 minutes.

11.10. SPE Column Wash of Solid Extracts with Hexane

11.10.1. Load the first 5 mL of hexane to soak for five minutes, and elute to waste.

11.10.2. Load the second 5 mL of hexane and elute to waste (without a soaking period).

11.10.3. Allow the column to dry with vacuum for 10 minutes. Columns must be dried before continuing.

11.11. SPE Elution of Solid Extracts – using 15 mL polypropylene test tube as receiving tube in the SPE manifold.

11.11.1. Rinse extraction bottles with 5 mL of 0.3% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Allow the solution to soak for 5 minutes and then elute into the 15 mL collection tube.

11.11.2. Repeat extract bottle to column reservoir rinse and cartridge elution with a second 5 mL aliquot of 0.3% NH_4OH/methanol. The total collection should be approximately 10 mL.

11.11.3. **Note: If the extracts will not be concentrated elute extract with a total of 8 mL of 0.3% NH_4OH/methanol.**

11.11.4. Proceed to Section 11.15.2 (Graphitized Carbon Cleanup) as needed. This is required for all DoD/DOE extracts.

11.12. Extract Concentration for Solid Samples (Note, if the extract will not be concentrated, proceed to Section 11.7)

11.12.1. Prior to concentrating each sample, add 200 uL of water.

11.12.2. Concentrate each sample under a gentle stream of nitrogen until the methanol is evaporated and the 200 uL of water remains.

11.12.2.1. This blow down must take a minimum of 3.5 hours.

11.12.2.2. Extracts can not remain in the water bath longer than 5 minutes once concentrated.

11.12.2.3. Add 600 uL of methanol and mix the contents well using a vortex mixer.

11.12.2.4. Add 200 uL of Internal Standard (IS) 250 ng/mL concentration solution to each extract and vortex to mix.

11.12.3. Transfer a portion of the extract to a 300 uL polypropylene autosampler vial (7 drop-wise or approximately ½ filled is sufficient). Archive the rest of the extracts for re-injection and dilution.

11.12.4. Seal the vial with a polypropylene screw cap. *Note: Teflon lined caps can not be used due to detection of low level concentration of PFAS.*

11.13. Product/Dispersion Samples

11.13.1. Check the solubility of the material in both methanol and water

11.13.1.1. If the material is soluble in water, dilute 0.5 mL of sample into 250 mL of DI water and proceed to Section 11.3 (follow water extraction procedures). Fortify sample appropriately with IDA or PFC spike solution, see Section 11.2.

11.13.1.2. If the material is soluble in methanol, dilute 1 g (if solid) or 1 mL (if liquid) of material into 10 mL of methanol (MeOH).

11.13.1.2.1. If the material does not completely dissolve, contact your immediate supervisor.

11.13.2. Take 100 uL of the 10 mL solution and dilute it to 10 mL in MeOH.

11.13.3. Take a 1 mL aliquot of this solution (effective dilution of 1000x (1 mg for solid or 0.001 mL for liquid)) and fortify with 0.5 mL of labeled IDA solution (Section 7.7).

11.13.4. DO NOT PASS EXTRACT THROUGH SPE CARTIRIDGE (omit steps 11.9 – 11.11).

11.13.5. Proceed to Section 11.6 of this SOP for extract concentration.

11.14. TOP (Total Oxidizable Precursor) Assay for Aqueous Samples

11.14.1. Prepare 3-250 mL HDPE containers with HPLC grade water to create the needed QC Samples (MB, LCS/LCSD).

11.14.2. Prepare enough 125 mL HDPE containers as needed for all “Pre” and “Post” samples, including QC. Label each appropriately.

11.14.3. Spike the “Pre” and “Post” MB 125 mL containers with 25 uL of the reverse surrogate solution of M2-4:2 FTS (Section 7.8).

11.14.4. Spike the “Pre” and “Post” LCS/LCSD 125 mL containers with 0.5 mL of the LCS Spike solution (Section 7.6), both regular and “add-on”, and 25 uL of the reverse surrogate solution (Section 7.8).

11.14.5. Remove the methanol solvent from all Post QC sample 125 mL containers (MB and LCS/LCSD) by using N2 evaporation.

11.14.6. Add 2g of potassium persulfate and 1.9 mL of 10 M NaOH to each “Post” sample container.

11.14.7. Subsample 100 mL aliquots of water from each field sample and QC from the 250 mL containers into each of the corresponding 125 mL containers for both the “Pre” and “Post” samples. Spike all “Pre” and “Post” samples with 25uL of the reverse surrogate solution (Section 7.8).

11.14.8. Set aside all “Pre” sample containers.

11.14.9. Cap each “Post” sample container, invert 2-3 times prior to placing container into water bath.

11.14.10. Add 2 g of potassium persulfate and 1.9 mL of 10N NaOH to each “Post” sample container.

11.14.11. Heat each “Post” sample container in a water bath (KD) at 85°C for 6 hours.

11.14.12. After digestion for 6 hours, place the “Post” sample containers in an ice bath for 30 minutes.

11.14.13. Adjust the pH of “Post” samples and associated QC aliquots to 7 with concentrated HCl. Use pH paper to determine the pH.

11.14.14. Spike both “Pre” and “Post” samples and their associated QC samples with 0.5 mL of PFC IDA solution (Section 7.7), both regular and add-on.

11.14.15. Use the following SPE procedure for both “Pre” and “Post” samples:

11.14.15.1. Set up WAX 150 mg/6 cc SPE columns for sample extraction using a vacuum manifold.

11.14.15.2. Establish a sample loading flow rate of 1 mL/minute for each port of the vacuum manifold, for as many ports as will be used simultaneously during sample loading.

11.14.15.3. Wash/condition the SPE column with 5 mL of 0.3% NH_4OH/Methanol, then 5 mL water.

11.14.15.4. Load 100 mL of sample onto the SPE cartridge at a flow rate of 1 mL/minute.

11.14.15.5. Add 5 mL rinse water

11.14.15.6. After the sample and water rinse have completely passed through the column, allow it to dry well using vacuum with a flow rate of 1 mL/minute for 15 minutes.

11.14.15.7. Wash the SPE column with 10 mL hexane rinse eluting all to waste.

11.14.15.8. Allow the column to dry well using vacuum with a flow rate of 1 mL/minute for 5 minutes. Columns must be dry before continuing.

11.14.15.9. Elute the samples into 15 mL polypropylene test tubes in the SPE manifold by rinsing each 125 mL sample container with 5 mL of 0.3% NH_4OH/methanol, and add to the SPE cartridge as eluent.

11.14.15.10. Repeat with another 5 mL of 0.3% NH_4OH/methanol.

11.14.15.11. Collect the 10 mL of eluent and concentrate per Section 11.6.

11.15. TOP (Total Oxidizable Precursor) Assay for Soil Samples

11.15.1. Weigh representative 2 g aliquots of soil for each “Pre” and “Post” sample into a 50 mL centrifuge tube.

11.15.2. For the method blank and LCS matrix, use 2 g each of Ottawa sand for each “Pre” and “Post” QC sample.

11.15.3. Add 20 mL of 0.4% KOH/methanol to each sample.

11.15.4. Shake each sample on an orbital shaker at room temperature for 3 hours.

11.15.5. Following the shaking, extract the samples in an ultrasonic water bath for an additional 12 hours.

11.15.6. After the completion of extraction, centrifuge each sample at 3500 rpm for 15 minutes.

11.15.7. Collect and decant the KOH/methanol extract to a new 50 mL centrifuge tube.

11.15.8. Add another 2 mL of 0.4% KOH/methanol solution to the residue, briefly shake to mix and centrifuge at 3500 rpm for 15 minutes.

11.15.9. Combine the rinsate to the first corresponding tubes.

11.15.10. Proceed to Section 11.16.2 (Envi-carb clean up)

11.15.11. To the final KOH/methanol extract, add 0.5 mL of water to each.

11.15.12. Concentrate the KOH/methanol/water extract under nitrogen to less than 0.25 mL.

11.15.13. Dilute extract up to 50 mL with water in the centrifuge tube and vortex.

11.15.14. Prepare enough 125 mL HDPE containers as needed for all “Pre” and “Post” samples, including QC. Label each appropriately.

11.15.15. Spike the “Pre” and “Post” MB 125 mL containers with 25 uL of the reverse surrogate solution of M2-4:2 FTS (Section 7.8).

11.15.16. Spike the “Pre” and “Post” LCS/LCSD 125 mL containers with 0.5 mL of the LCS Spike solution and 25 uL of the reverse surrogate solution (Section 7.8).

11.15.17. Remove the methanol solvent from all “Post” QC sample 125 mL containers (MB and LCS/LCSD) by using N2 evaporation.

11.15.18. Add 2g of potassium persulfate and 1.9 mL of 10N NaOH to each “Post” sample container.

11.15.19. Transfer extract from the centrifuge tube to the appropriate 125 mL container.

11.15.20. Rinse the centrifuge container with an additional 50 mL of water and transfer to the appropriate 125 mL container.

11.15.21. Set aside all “Pre” sample containers.

11.15.22. Cap each “Post” sample container, invert 2-3 times prior to placing container into water bath.

11.15.23. Heat each “Post” sample container in a water bath (KD) at 85°C for 6 hours.

11.15.24. After digestion for 6 hours, place the “Post” sample containers in an ice bath for 30 minutes.

11.15.25. Adjust the pH of “Post” samples and associated QC aliquots to 7 with concentrated HCl. Use pH paper to determine the pH.

11.15.26. Spike both “Pre” and “Post” samples and their associated QC samples with 0.5 mL of PFC IDA solution (Section 7.7).

11.15.27. Use the following SPE procedure for both “Pre” and “Post” samples:

11.15.27.1. Set up WAX 150 mg/6 cc SPE columns for sample extraction using a vacuum manifold.

11.15.27.2. Establish a sample loading flow rate of 1 mL/minute for each port of the vacuum manifold, for as many ports as will be used simultaneously during sample loading.

11.15.27.3. Wash/condition the SPE column with 5 mL of 0.3% NH_4OH/Methanol, then 5 mL water.

11.15.27.4. Load 100 mL of sample onto the SPE cartridge at a flow rate of 1 mL/minute.

11.15.27.5. Add 5 mL rinse water

11.15.27.6. After the sample and water rinse have completely passed through the column, allow it to dry well using vacuum with a flow rate of 1 mL/minute for 15 minutes.

11.15.27.7. Wash the SPE column with 10 mL hexane rinse eluting all to waste.

11.15.27.8. Allow the column to dry well using vacuum with a flow rate of 1 mL/minute for 5 minutes. Columns must be dry before continuing.

11.15.27.9. Elute the samples into 15 mL polypropylene test tubes in the SPE manifold by rinsing each 125 mL sample container with 5 mL of 0.3% NH_4OH/methanol, and add to the SPE cartridge as eluent.

11.15.27.10. Repeat with another 5 mL of 0.3% NH_4OH/methanol.

11.15.27.11. Collect the 10 mL of eluent and concentrate per Section 11.6.

Note: *If the extracts will not be concentrated elute extract with a total of 8 mL (2 4 mL rinses) of 0.3%* NH_4OH*/methanol.*

11.16. Other Types of Sample Cleanup

11.16.1. Freezing technique to remove lipids.

If samples contain lipids then freeze the methanolic extract and QC extracts at -20°C for at least 1 hour. Collect the solvent layer.

11.16.2. Cleanup with graphitized carbon will be applied to all samples as needed but is required for all DoD/DOE extracts.

11.16.2.1. Add 100 mg of graphitized carbon to each sample extract and QC extracts.

11.16.2.2. Shake vigorously and then let sit for 10 minutes.

11.16.2.3. Centrifuge each sample for 2 minutes at 1000 rpm.

11.16.2.4. Decant the solvent layer.

11.16.2.5. Proceed to Section 11.6, 11.7 or 11.12 as applicable.

11.17. AFFF Sample Preparation

11.17.1. QC for AFFF samples consists of a method blank, a laboratory control sample and a sample or matrix duplicate only. No matrix spike or matrix spike duplicate is needed.

11.17.2. Perform a 1,000,000 X serial dilution of the AFFF sample. Dilute 1 mL of AFFF sample to 1L with laboratory supplied water. Then dilute 1mL of this dilution to 1L with laboratory supplied water.

11.17.2.1. Be sure to retain all dilutions should the initial analysis warrant re-analysis at higher concentration.

11.17.3. Subsample 2.0 mL of this dilution and fortify with 0.5 mL IDA solution and 0.5mL of IS (50 ng/mL) solution: then add 7.0 mL of methanol.

11.17.4. Transfer a portion of the sample to a 300 uL polypropylene autosampler vial (7 drop-wise or approximately ½ filled is sufficient). Archive the rest of the sample for re-injection or dilution.

11.18. Instrument Analysis

Suggested operating conditions are listed in Tables 1-7 for the Waters and SCIEX LCMS systems:

Table 1 - Recommended Instrument Operating Conditions				
HPLC Conditions (Shimadzu HPLC)				
Column (Column temp = 45°C)	Phenomenex Gemini 3 µm C18 110Å, 50 X 2 mm			
Mobile Phase Composition	A = 20 mM Ammonium Acetate in Water B = Methanol			
Gradient Program	**Time**	**%A**	**%B**	**Flow Rate - mL/min**
	0	90	10	0.60
	0.1	45	55	0.60
	4.5	1	99	0.60
	4.95	1	99	0.60
	5	90	10	0.60
	Maximum pressure limit = 5,000 psi			
Injection Size	2 µL (fixed amount throughout the sequence). If non-concentrated extract then use 20 uL.			
Run Time	~6.6 minutes			
Mass Spectrometer Interface Settings (SCIEX 5500)				
MS Interface Mode	ESI Negative Ion. Minimum of 10 scans/peak.			
Ion Spray Voltage (kV)	4.5			

Table 1 - Recommended Instrument Operating Conditions

HPLC Conditions (Shimadzu HPLC)

Entrance Potential (V)	5
Declustering Potential (V)	25
Desolvation Temp	600ºC
Curtain Gas	35 psi
Collision Gas	8 psi

Table 2 - Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

Compound	Comments	Reaction (MRM)	Dwell (sec)	Ent. Pot. (V)	Col. Energy (V)	Declu. Pot. (V)	Cell Exit Pot. (V)	Typ RT (Min)
PFBA	Native analyte	212.9 > 169	0.011	-5	-12	-25	-31	1.74
13C4-PFBA	IDA	217 > 172	0.011	-5	-12	-25	-31	1.74
PFBS	Native analyte	298.9 > 80	0.011	-6	-58	-55	-37	1.76
PFBS_2	Native analyte	298.9 > 99	0.011	-5	-40	-55	-12	1.76
13C3-PFBS	IDA	301.9 > 83	0.011	-5	-40	-55	-12	1.76
PFPeA	Native analyte	262.9 > 219	0.011	-7	-12	-20	-34	1.99
13C5-PFPeA	IDA	267.9 > 223	0.011	-7	-12	-20	-35	1.99
4:2 FTS	Native analyte	327 > 307	0.011	-7	-32	-50	-10	2.06
M2-4:2FTS	IDA or Reverse Surrogate for TOP	329 > 81	0.011	-7	-32	-50	-10	2.06
PFHxA	Native analyte	313 > 269	0.011	-5	-12	-25	-37	2.25
PFHxA_2	Native analyte	313 > 119	0.011	-5	-12	-25	-37	2.25
13C2-PFHxA	IDA	315 > 270	0.011	-5	-12	-25	-38	2.25
PFHpA	Native analyte	363 > 319	0.011	-6	-12	-25	-41	2.57
PFHpA_2	Native analyte	363 > 169	0.011	-6	-12	-25	-41	2.57
13C4-PFHpA	IDA	367 > 322	0.011	-6	-12	-25	-41	2.57
PFPeS	Native analyte	349 > 80	0.011	-9	-66	-57	-40	2.15
PFPeS_2	Native analyte	349 > 99	0.011	-9	-40	-57	-12	2.15
PFHxS	Native analyte	399 > 80	0.011	-12	-74	-60	-43	2.59
PFHxS_2	Native analyte	399 > 99	0.011	-12	-74	-60	-43	2.59
18O2-PFHxS	IDA	403 > 84	0.011	-12	-74	-60	-43	2.59
6:2 FTS	Native analyte	427 > 407	0.011	-7	-32	-50	-10	2.91
M2-6:2FTS	IDA	429 > 81	0.011	-7	-32	-50	-10	2.91
PFOA	Native analyte	413 > 369	0.011	-6	-14	-25	-44	2.93
PFOA_2	Native analyte	413 > 169	0.011	-5	-22	-25	-12	2.93
13C4-PFOA	IDA	417 > 372	0.011	-6	-14	-25	-44	2.93
13C2-PFOA	IS	415 > 370	0.011	-6	-14	-25	-44	2.93
PFHpS	Native analyte	449 > 80	0.011	-11	-88	-65	-46	2.94
PFHpS_2	Native analyte	449 > 99	0.011	-11	-88	-65	-46	2.94
PFNA	Native analyte	463 > 419	0.011	-6	-14	-25	-47	3.29
PFNA_2	Native analyte	463 > 169	0.011	-6	-14	-25	-47	3.29

Table 2 - Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500)

Compound	Comments	Reaction (MRM)	Dwell (sec)	Ent. Pot. (V)	Col. Energy (V)	Declu. Pot. (V)	Cell Exit Pot. (V)	Typ RT (Min)
13C5-PFNA	IDA	468 > 423	0.011	-6	-14	-25	-48	3.29
PFOS	Native analyte	499 > 80	0.011	-9	-108	-65	-50	3.29
PFOS_2	Native analyte	499 > 99	0.011	-5	-58	-65	-12	3.29
PFNS	Native analyte	549 > 80	0.011	-10	-113	-75	-52	3.40
PFNS_2	Native analyte	549 > 99	0.011	-8	-71	-75	-12	3.40
PFDoS	Native analyte	699 > 80	0.011	-11	-76	-10	-11	4.48
PFDoS_2	Native analyte	699 >99	0.011	-11	-130	-10	-5	4.48
13C4-PFOS	IDA	503 > 80	0.011	-9	-108	-65	-50	3.29
PFDA	Native analyte	513 > 469	0.011	-6	-16	-25	-51	3.65
PFDA_2	Native analyte	513 > 169	0.011	-6	-16	-25	-51	3.65
13C2-PFDA	IDA	515 > 470	0.011	-6	-16	-25	-51	3.65
8:2 FTS	Native analyte	527 > 507	0.011	-7	-40	-50	-15	3.65
10:2 FTS	Native analyte	627 > 607	0.011	-7	-38	-110	-5	4.25
M2-8:2FTS	IDA	529 > 81	0.011	-7	-40	-50	-15	3.65
PFOSA	Native analyte	498 > 78	0.011	-8	-85	-60	-50	3.7
13C8-PFOSA	IDA	506 > 78	0.011	-8	-85	-60	-50	3.7
N-MeFOSAA	Native analyte	570 > 419	0.011	-7	-36	-40	-15	3.82
d3-MeFOSAA	IDA	573 > 419	0.011	-7	-36	-40	-15	3.82
PFDS	Native analyte	599 > 80	0.011	-11	-118	-85	-54	3.96
PFDS_2	Native analyte	599 > 99	0.011	-11	-118	-85	-54	3.96
PFUdA	Native analyte	563 > 519	0.011	-7	-18	-25	-54	3.97
PFUdA_2	Native analyte	563 > 169	0.011	-7	-18	-25	-54	3.97
13C2-PFUdA	IDA	565 > 520	0.011	-7	-18	-25	-54	3.97
N-EtFOSAA	Native analyte	584 > 419	0.011	-7	-36	-50	-15	3.99
d5-EtFOSAA	IDA	589 > 419	0.011	-7	-36	-50	-15	3.99
PFDoA	Native analyte	613 > 569	0.011	-5	-18	-25	-54	4.3
PFDoA_2	Native analyte	613 > 169	0.011	-5	-18	-25	-54	4.3
13C2-PFDoA	IDA	615 > 570	0.011	-5	-18	-25	-54	4.3
PFTrDA	Native analyte	663 > 619	0.011	-7	-20	-25	-54	4.56
PFTrDA_2	Native analyte	663 > 169	0.011	-7	-20	-25	-54	4.56
PFTeDA	Native analyte	713 > 169	0.011	-2	-22	-25	-10	4.79
PFTeDA_2	Native analyte	713 > 219	0.011	-7	-36	-25	-30	4.79
13C2-PFTeDA	IDA	715 > 670	0.011	-2	-22	-25	-10	4.79
PFHxDA	Native analyte	813 > 769	0.011	-7	-24	-25	-54	5.25
PFHxDA_2	Native analyte	813 > 169	0.011	-7	-24	-25	-54	5.25
13C2-PFHxDA	IDA	815 > 770	0.011	-7	-24	-25	-54	5.25
PFODA	Native analyte	913 > 869	0.011	-7	-26	-25	-54	5.55
PFODA_2	Native analyte	913 > 169	0.011	-7	-26	-25	-54	5.55

Table 3 - Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (SCIEX 5500) for Fluorinated Replacement Chemicals

Compound	Comments	Reaction (MRM)	Dwell (sec)	Ent. Pot. (V)	Col. Energy (V)	Declu. Pot. (V)	Cell Exit Pot. (V)	Typ RT (Min)
HFPO-DA	Native analyte	329.1 > 285	0.011	-10	-6	-48	-17	2.06
13C3-HFPO-DA	IDA	332.1 > 287	0.011	-10	-10	-40	-17	2.06
9Cl-PF3ONS (F53B major)	Native analyte	531 > 351	0.011	-10	-30	-120	-17	3.23
11Cl-PF3OUdS (F53B minor)	Native analyte	631 > 451	0.011	-10	-40	-160	-17	3.84
Dona	Native analyte	377 > 251	0.011	-10	-16	-55	-17	2.33
Dona_2	Native analyte	377 > 85	0.011	-10	-35	-55	-17	2.33

Table 4 - Retention Times & Quantitation (SCIEX 5500)

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	1.54	13C4-PFBA	1.54	Isotope Dilution
PFPeA	1.56	13C5-PFPeA	1.56	Isotope Dilution
PFBS	1.78	13C3-PFBS	1.78	Isotope Dilution
PFHxA	2.03	13C2-PFHxA	2.03	Isotope Dilution
PFPeS	2.06	13C3-PFBS	1.78	Isotope Dilution
PFHpA	2.36	13C4-PFHpA	2.36	Isotope Dilution
PFHxS	2.37	18O2-PFHxS	2.37	Isotope Dilution
PFOA	2.71	13C4-PFOA	2.71	Isotope Dilution
PFHpS	2.72	13C4-PFOS	3.09	Isotope Dilution
PFNA	3.09	13C5-PFNA	3.09	Isotope Dilution
PFOS	3.09	13C4-PFOS	3.09	Isotope Dilution
PFNS	3.40	13C4-PFOS	3.09	Isotope Dilution
PFDA	3.45	13C2-PFDA	3.45	Isotope Dilution
FOSA	3.43	13C8-FOSA	3.43	Isotope Dilution
PFDS	3.77	13C4-PFOS	3.09	Isotope Dilution
PFUdA	3.78	13C2-PFUdA	3.78	Isotope Dilution
PFDoA	4.07	13C2-PFDoA	4.07	Isotope Dilution
PFTrDA	4.34	13C2-PFDoA	4.07	Isotope Dilution
PFDoS	4.48	13C4-PFOS	3.09	Isotope Dilution
PFTeDA	4.58	13C2-PFTeDA	4.58	Isotope Dilution
PFHxDA	4.99	13C2-PFHxDA	4.99	Isotope Dilution
PFODA	5.34	13C2-PFHxDA	4.99	Isotope Dilution
EtFOSAA	3.78	d5-EtFOSAA	3.78	Isotope Dilution
MeFOSAA	3.61	d3-MeFOSAA	3.60	Isotope Dilution

Table 4 - Retention Times & Quantitation (SCIEX 5500)

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
4:2 FTS	1.98	M2-4:2 FTS (If TOP then 13C-PFBS)	1.78	Isotope Dilution
6:2FTS	2.69	M2-6:2FTS	2.69	Isotope Dilution
8:2FTS	3.44	M2-8:2FTS	3.44	Isotope Dilution
HFPO-DA	2.06	13C3-HFPO-DA	2.06	Isotope Dilution
9Cl-PF3ONS (F53B major)	3.23	13C4-PFOS	3.09	Isotope Dilution
11Cl-PF3OUdS (F53B minor)	3.84	13C4-PFOS	3.09	Isotope Dilution
Dona	2.33	13C4-PFOS	3.09	Isotope Dilution
10:2 FTS	4.25	M2-8:2 FTS	3.44	Isotope Dilution

Table 5 - Recommended Instrument Operating Conditions

HPLC Conditions (Waters Acquity UPLC)					
Column (Column temp = 50°C)	Waters Acquity BEH 1.7µm C18, 3.0 x 150 mm				
Mobile Phase Composition	A = 20 mM Ammonium Acetate in Water B = Methanol				
Gradient Program	**Time**	**%A**	**%B**	**Curve**	**Flow Rate - mL/min.**
	0	98	2	6	0.30
	1	98	2	6	0.30
	2	50	50	6	0.30
	12	10	90	6	0.30
	12.5	0	100	6	0.30
	16	0	100	6	0.30
	16.2	98	2	6	0.30
	Maximum pressure limit = 15,000 psi				
Injection Size	10 µL (fixed amount throughout the sequence)				
Run Time	~20 minutes				
Mass Spectrometer Interface Settings (Quattro Premier XE)					
MS Interface Mode	ESI Negative Ion. Minimum of 10 scans/peak.				
Capillary (kV)	2.8				
Cone (V)	Varies from 8.0 to 65				
Extractor (V)	3				
Source Temp	135ºC				
Desolvation Temp	350ºC				
Cone Gas (nitrogen) Flow	25 L/hour				
Desolvation Gas (nitrogen) Flow	1100 L/hour				

Table 6 - Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (Quattro Premier XE)

Compound	Comments	Reaction (MRM)	Dwell (sec)	Cone Volt.	Col. Energy	Function Number
PFBA	Native analyte	213 > 169	0.02	8	10	1
13C4-PFBA	IDA	217 > 172	0.02	12	10	1
PFPeA	Native analyte	263 > 219	0.02	10	10	2
13C5-PFPeA	IDA	268 > 223	0.02	11	9	2
PFBS	Native analyte	299 > 80	0.02	45	35	2
PFBS_2	Native analyte	299 > 99	0.02	45	35	2
13C3-PFBS	IDA	302 > 83	0.02	45	35	2
PFHxA	Native analyte	313 > 269	0.02	10	10	3
PFHxA_2	Native analyte	313 > 119	0.02	10	10	3
13C2-PFHxA	IDA	315 > 270	0.02	12	9	3
PFHpA	Native analyte	363 > 319	0.02	10	10	4
PFHpA_2	Native analyte	363 > 169	0.02	10	10	4
13C4-PFHpA	IDA	367 > 322	0.02	12	10	4
PFHxS	Native analyte	399 > 80	0.02	55	35	4
PFHxS_2	Native analyte	339 > 99	0.02	55	35	4
18O2-PFHxS	IDA	403 > 84	0.02	50	40	4
PFOA	Native analyte	413 > 369	0.02	12	10	5
PFOA_2	Native analyte	413 > 169	0.02	12	10	5
13C2-PFOA	IS	415 > 370	0.02	12	12	5
13C4-PFOA	IDA	417 > 372	0.02	12	12	5
PFHpS	Native analyte	449 > 80	0.02	60	38	5
PFHpS_2	Native analyte	449 > 99	0.02	60	38	5
PFNA	Native analyte	463 > 419	0.02	16	10	7
PFNA_2	Native analyte	463 > 169	0.02	16	10	7
13C5-PFNA	IDA	468 > 423	0.02	12	12	7
PFOS	Native analyte	499 > 80	0.02	60	40	6
PFOS_2	Native analyte	499 > 99	0.02	60	40	6
PFNS	Native analyte	549 > 80	0.02	60	40	6
PFNS_2	Native analyte	549 > 99	0.02	60	40	6
13C4-PFOS	IDA	503 > 80	0.02	35	48	6
PFDA	Native analyte	513 > 469	0.02	16	12	8
PFDA_2	Native analyte	513 > 169	0.02	16	12	8
13C2-PFDA	IDA	515 > 470	0.02	14	12	8
PFUdA	Native analyte	563 > 519	0.02	15	12	10
PFUdA_2	Native analyte	563 > 169	0.02	15	12	10
13C2-PFUdA	IDA	565 > 520	0.02	14	12	10
PFDS	Native analyte	599 > 80	0.02	74	48	10
PFDS_2	Native analyte	559 > 99	0.02	74	48	10
FOSA	Native analyte	498 > 78	0.02	40	32	9

Table 6 - Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings (Quattro Premier XE)

Compound	Comments	Reaction (MRM)	Dwell (sec)	Cone Volt.	Col. Energy	Function Number
13C8-FOSA	IDA	506 > 78	0.02	48	32	9
PFDoA	Native analyte	613 > 569	0.02	15	14	11
PFDoA_2	Native analyte	613 > 169	0.02	15	14	11
13C2-PFDoA	IDA	615 > 570	0.02	16	12	11
PFTrDA	Native analyte	663 > 619	0.02	12	12	11
PFTrDA_2	Native analyte	663 > 169	0.02	12	12	11
PFTeDA	Native analyte	713 > 169	0.02	12	18	11
PFTeDA_2	Native analyte	713 > 219	0.02	12	18	11
13C2-PFTeDA	IDA	715 > 670	0.02	15	15	11
PFHxDA	Native analyte	813 > 769	0.02	18	15	12
PFHxDA_2	Native analyte	813 > 169	0.02	18	15	12
PFODA	Native analyte	913 > 869	0.02	20	16	12
PFODA_2	Native analyte	913 > 169	0.02	20	16	12
13C2-PFHxDA	IDA	815 > 770	0.02	18	15	12
EtFOSAA	Native analyte	584 > 419	0.02	35	20	9
d5-EtFOSAA	IDA	589 > 419	0.02	30	25	9
MeFOSAA	Native analyte	570 > 419	0.02	30	28	9
d3-MeFOSAA	IDA	573 > 419	0.02	30	25	9
4:2FTS	Native analyte	327 > 307	0.02	40	30	5
M2-4:2FTS	IDA or Reverse Surrogate for TOP	329 > 81	0.02	40	30	5
6:2FTS	Native analyte	427 > 407	0.02	40	30	5
M2-6:2FTS	IDA	429 > 81	0.02	40	28	5
8:2FTS	Native analyte	527 > 507	0.02	40	28	8
M2-8:2FTS	IDA	529 > 81	0.02	40	28	8

Table 7 - Recommended Instrument Operating Conditions

Retention Times & Quantitation (Quattro Premier XE)

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	4.77	13C4-PFBA	4.79	Isotope Dilution
PFPeA	5.90	13C5-PFPeA	5.92	Isotope Dilution
PFBS	6.01	13C3-PFBS	6.01	Isotope Dilution
PFHxA	7.22	13C2-PFHxA	7.25	Isotope Dilution
PFPeS	7.20	18O2-PFHxS	8.64	Isotope Dilution
PFHpA	8.57	13C4-PFHpA	8.59	Isotope Dilution
PFHxS	8.60	18O2-PFHxS	8.64	Isotope Dilution
PFOA	9.80	13C4-PFOA	9.83	Isotope Dilution
PFHpS	9.80	13C4-PFOS	10.90	Isotope Dilution

Table 7 - Recommended Instrument Operating Conditions

Retention Times & Quantitation (Quattro Premier XE)

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFNA	10.88	13C5-PFNA	10.92	Isotope Dilution
PFOS	10.87	13C4-PFOS	10.90	Isotope Dilution
PFNS	11.70	13C4-PFOS	10.90	Isotope Dilution
PFDA	11.82	13C2-PFDA	11.86	Isotope Dilution
FOSA	12.41	13C8-FOSA	12.46	Isotope Dilution
PFDS	12.57	13C4-PFOS	10.90	Isotope Dilution
PFUdA	12.62	13C2-PFUdA	12.66	Isotope Dilution
PFDoA	13.32	13C2-PFDoA	13.34	Isotope Dilution
PFTrDA	13.91	13C2-PFDoA	13.34	Isotope Dilution
PFTeDA	14.39	13C2-PFTeDA	14.39	Isotope Dilution
PFHxDA	15.16	13C2-PFHxDA	15.16	Isotope Dilution
PFODA	15.57	13C2-PFHxDA	15.16	Isotope Dilution
EtFOSAA	12.63	d5-EtFOSAA	12.62	Isotope Dilution
MeFOSAA	12.3	d3-MeFOSAA	12.28	Isotope Dilution
4:2FTS	7.02	M2-4:2 FTS (If TOP then 13C-PFBS)	6.01	Isotope Dilution
6:2FTS	10.08	M2-6:2FTS	10.08	Isotope Dilution
8:2FTS	11.95	M2-8:2FTS	11.95	Isotope Dilution

11.18.1. Post Spike Sample Analysis for AFFF samples

11.18.1.1. This section only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of <LOQ (RL) for any analyte.

11.18.1.2. Spike aliquots of the sample at the final dilution reported for the sample with all analytes that have reported of <LOQ in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the < LOQ value).

11.18.1.3. When analyte concentrations are calculated as <LOQ, the spike must recover within 70-130% of its true value.

11.18.1.4. It the recovery does not meet this criteria, the sample, sample duplicate and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.

11.18.2. Tune and calibrate the instrument as described in Section 10.

11.18.3. A typical run sequence is as follows:

- Rinse Blank (RB, not linked to anything)

- Start ICAL with CCVL but called IC in TALS (starts the 12 hour clock or time 0:00)
- Rest of ICAL
- ICB: link to midpoint of ICAL and samples
- ICV: link to midpoint of ICAL and samples (If ICAL good)
- CCB: link to midpoint of ICAL and samples
- PFOA RT marker (as needed)
- Rinse Blank (RB, not linked to anything)
- 10 samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- 10 more samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- Etc.
- CCVL (within 12 hours from CCVL in ICAL, can be the ending CCV and starts 12 hours all over again): if this occurs link to the midpoint of the ICAL/toggle it as opening/closing CCV.
- CCV: link to midpoint of ICAL
- 10 samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- If no ICAL run that day
- CCB: link to CCVIS
- CCVL (starts 12 hour clock): link to CCVIS
- CCVIS: link to midpoint of ICAL
- 10 samples: link to CCVIS
- CCV: link to CCVIS
- 10 samples: link to CCVIS
- CCV: link to CCVIS
- Etc.
- If going over 12 hours in the sequence: CCVL (within 12 hours from CCVL at item 2 above, can be the ending CCV and starts 12 hours all over again): if this occurs link to the CCVIS /toggle as opening and closing CCV.
- CCV: link to CCVIS
- 10 samples: link to CCVIS
- CCV: link to CCVIS

12. CALCULATIONS

12.1. If the concentration of the analyte ions exceeds the working range as defined by the calibration standards, then the sample must be diluted and reanalyzed. It may be necessary to dilute samples due to matrix.

12.2. Qualitative Identification

12.2.1. The retention times of PFAS with labeled standards should be the same as that of the labeled IDA's to within 0.05 min. For PFAS with no labeled standards, the RT must be within ± 0.3 minutes of the ICV and CCV standards. ***Note****: The IDA RT and native RT may be offset by 0.02 to 0.04 minutes.*

12.3. The ICAL established in Section 10 is used to calculate concentrations for the extracts.

12.4. Extract concentrations are calculated as below. The first equation applies to the linear fit, the second to the quadratic line fit.

Equation 3

$$\text{Concentration, ng/mL} = \frac{y - c}{b}$$

Equation 4

$$\text{Concentration, ng/mL} = \frac{-b + \sqrt{b^2 - 4a(c - y)}}{2a}$$

Where:

$$y = \frac{\text{Area (analyte)}}{\text{Area (IS)}} \times \text{Concentration (IS)}$$

x = concentration
a = curvature
b = slope
c = intercept

12.5. Water Sample Result Calculation:

Equation 5

$$\text{Concentration, ng/L} = \frac{C_{ex} V_t}{V_o}$$

Where:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
V_o = Volume of water extracted (L)

12.6. Soil Sample Result Calculation:

Equation 6

$$\text{Concentration}, ng/g = \frac{C_{ex}V_t}{W_s D}$$

Where ng/g = µg/kg and:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
W_s = Weight of sample extracted (g)
D = Fraction of dry solids, which is calculated as follows:

$$\frac{100 - \%\,\text{moisture in sample}}{100} \quad \text{(for dry weight result)}$$

12.7. IDA Recovery Calculation:

Equation 7

$$\%\,\text{Recovery} = \frac{A_t Q_{is}}{A_{is} Q_t RRF_{IDA}} X100$$

Where ng/g = µg/kg and:

RF_{IDA} = Response Factor for IDA compound
A_t = Area response for IDA compound
A_{IS} = Area Response for IS compound
Q_{IS} = Amount of IS added
Q_t = Amount of IDA added

12.8. Raw data, calibration summaries, QC data, and sample results are reviewed by the analyst. These must also be reviewed thoroughly by a second qualified person. See the Data Review Policy (WS-PQA-0012). These reviews are documented on the Data Review Checklist.

13. METHOD PERFORMANCE

13.1. The group/team leader has the responsibility to ensure that this procedure is performed by an associate who has been properly trained in its use and has the required expertise.

13.2. Method Detection Limit

The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in SOP WS-QA-0006 and policy WS-PQA-003. MDLs are available in the Quality Assurance Department.

13.3. Initial Demonstration of Capability (IDOC)

Each analyst performing this procedure must successfully analyze four LCS QC samples using current laboratory LCS control limits. IDOCs are approved by the

Quality Assurance Manager and the Technical Director. IDOC records are maintained by the QA staff in the central training files.

13.4. The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in WS-QA-0006 and policy WS-PQA-003.

14. POLLUTION PREVENTION

14.1. All waste will be disposed of in accordance with Federal, State and Local regulations.

14.2. Solid phase extraction used for water samples greatly reduces the amount of solvent used compared to liquid-liquid extraction.

14.3. Standards and reagents are purchased and prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.4. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in Section 13 of the Corporate Safety Manual for “Waste Management and Pollution Prevention.”

14.5. Do not allow waste solvent to vent into the hoods. All solvent waste is stored in capped containers unless waste is being transferred.

14.6. Transfer waste solvent from collection cups (tri-pour and similar containers) to jugs and/or carboys as quickly as possible to minimize evaporation.

15. WASTE MANAGEMENT

The following waste streams are produced when this method is carried out:

15.1. Assorted test tubes, autovials, syringes, filter discs and cartridges. Dump the solid waste into a yellow contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the hazardous waste – landfill steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.2. Extracted soil samples, used sodium sulfate, paper funnel filters, glass wool, thimbles, and extracted solids saturated with solvents. Dump these materials into an orange contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the incineration steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.3. Waste Methanol. Collect the waste solvents in tripours during use. Empty the tripours into a 1-liter to 4-liter carboy at the fume hood. When the carboy is full, or at the end of your shift, whichever comes first, empty the carboy into the steel flammable solvent drum in the H3 closet. When full to no less than six inches of the top, or after no more than 75 days, move the steel flammable solvent drum to the waste collection area for shipment.

15.4. Mixed water/methanol waste from soil extraction. Collect the waste in the HPLC waste carboy. When full, or after no more than one year, dump into the blue plastic HPLC collection drum in the H3 closet. When the drum is full, to no less than six inches of the top, or after no more than 75 days, move it to the waste collection area for shipment.

15.5. Aqueous acidic waste from the LCMS instrument contaminated with methanol. This is collected in a 1-gallon carboy at the instrument. When the carboy is full, or after no more than one year, it is emptied into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between two and six inches of the top, or after no more than 75 days, move it to the waste collection area for shipment.

15.6. Autovials contaminated with methanol. As the autovials are removed from the instrument after analysis, they are collected in open containers at the instrument. After all autovials are removed, the open container must be dumped into a closed satellite collection container in a fume hood, as the punctured septa in the autovial can allow methanol and other contaminants to evaporate into the atmosphere. The satellite collection containers are transferred to the waste disposal area when full or after no more than one year, where they are disposed through the vial eater.

16. REFERENCES

16.1. Cheryl Moody, Wai Chi Kwan, Johnathan W. Martin, Derek C. G. Muir, Scott A. Mabury, “Determination of Perfluorinated Surfactants in Surface Water Samples by Two Independent Analytical Techniques: Liquid Chromatography/Tandem Mass Spectrometry and 19FNMR,” Analytical Chemistry 2001, 73, 2200-2206.

16.2. John Giesy et al., “Accumulation of Perfluorooctane Sulfonate in Marine Mammals”, Environmental Science & Technology, 2001 Vol. 35, No. 8, pages 1593-1598.

16.3. U.S. EPA, “Residue Chemistry Test Guidelines, OPPTS 860.1340, Residue Analytical Method”, EPA 712-C-95-174, August 1995.

16.4. STL Denver White Paper DEN-W-LC-002, “Method Validation Study for Analysis of Ammonium Perfluorooctanate in Soil Matrices by High Performance Liquid

Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, September 5, 2003.

16.5. STL Denver White Paper DEN-W-LC-003, "Addendum A to Method Validation Study for Analysis of Ammonium Perfluorooctanate in Soil Matrices by High Performance Liquid Chromatography/Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, August 6, 2003.

16.6. STL Denver White Paper DEN-W-LC-004, "Method Validation Study for Analysis of Perfluorooctanoic Acid in Waters by High Performance Liquid Chromatography/Tandem Mass Spectrometry (HPLC/MS/MS)", Mark Dymerski, January 26, 2005.

16.7. Waters application note; "Acquity UPLC System for Quantifying Trace Levels of Perfluorinated Compounds with an Acquity PFC Analysis Kit", Peter J. Lee, Evan T. Bernier, Gordon T. Fujimoto, Jeremy Shia, Michael S. Young, and Alice J. Di Gloia, Waters Corporation, Milford, MA. USA.

16.8. US EPA, "Method 537 - Determination of Selected Perfluorinated alkyl acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometery (LC/MS/MS)", Version 1.1, September 2009, J.A. Shoemaker, P.E. Grimmett, B.K. Boutin, EPA Document #: EPA/600/R-08/092

16.9. Erika F. Houtz and David L. Sedlak, "Oxidative Conversion as a Means of Detecting Precursors to Perfluoroalkyl Acids in Urban Runoff," Environmental Science and Technology 46, no. 17 (2012): 9342-49.

17. METHOD MODIFICATIONS

17.1. Modifications from Method 537 are detailed below:

17.1.1. Water sample containers are not preserved with Trizma.

17.1.2. The method has been modified to address soil/solid matrices. The extraction holding time is set at 14 days.

17.1.3. The analyte list has been expanded. The number of labeled analytes has been expanded as well to improve quantitation.

17.1.4. The reporting limits differ as they are all set at one consistent value.

17.1.5. Calibration levels differ from the referenced method.

17.1.6. More labeled analytes are fortified into the samples prior to the extraction process. Most target analytes are quantitated against a labeled analyte.

17.1.7. There is no symmetry requirement.

17.1.8. Calibration, both initial and continuing, has different acceptance criteria due to the longer list of analytes, and the use of isotope dilution quantitation.

17.1.9. The eluents and HPLC configuration differs. As a result the final extract is in 80:20 methanol:water.

17.1.10. The LCS and MS/MSD are spiked at one concentration and do not rotate between a low to high levels.

17.1.11. Samples are not checked for residual chlorine or pH.

17.1.12. A different SPE cartridge (Waters OASIS WAX) is used for the extraction process. As a result solvents and elution procedures are different.

18. ATTACHMENTS

18.1. Attachment 1 - Analysis of Perfluorinated Compounds (PFAS) in Water via In Line Solid Phase Extraction (SPE).

19. REVISION HISTORY

Revisions to Attachment 1 are documented in the attachment.

Revisions prior to 05/01/2017 have been removed and are available in previous versions of this SOP.

19.1. WS-LC-0025, Revision 3.3, Effective 12/03/2018

19.1.1. Added Section 6.9, “Phenomenex Gemini 3 µm C18 110A, 50 X 3 mm, Part No. 00B-4439-Y0.”

19.1.2. Tables 2 and 6 revised comment for M2-4:2 FTS to, “IDA or Reverse Surrogate for TOP”.

19.1.3. Tables 4 and 7 revised header from “IS Analog” to “IDA Analog”, and revised “4:2 FTS” entry to “M2-4:2 FTS (If TOP then 13C-PFBS)”.

19.1.4. Editorial changes.

19.2. WS-LC-0025, Revision 3.2, Effective 08/20/2018

19.2.1. Section 1 added, “1H,1H,2H,2H-perfluorododecane sulfonate” and “Perfluoro-1-dodecansulfonic acid” entries to table.

19.2.2. Section 1.2 revised table entry for “Adona” to “Dona”.

19.2.3. Section 7.4 added, “PFDoS” and “10:2 FTS” entries to table.

19.2.4. Section 7.4 revised, “Adona” entry to “Dona”.

19.2.5. Table 2 added, “PFDoS”, “PFDoS_2”, and “10:2 FTS” entries to table.

19.2.6. Table 3 revised, “Adona” and “Adona_2” entries to “Dona” and “Dona_2”.

19.2.7. Table 4 added, “PFDoS” and “10:2 FTS” entries to table.

19.2.8. Table 4 revised, “Adona entry to “Dona”.

19.2.9. Editorial changes.

19.3. WS-LC-0025, Revision 3.1, Effective 06/21/2018

19.3.1. Section 11.2.1 revised to, “Visually inspect samples for the presence of settled and/or suspended sediment/particulates. If present or if the sample is biphasic add IDA prior to any sample decanting or centrifugation. If the sample requires decanting or centrifugation contact the client for guidance prior to such action. Decanting or filtering of the sample can lead to a low bias.”

19.3.2. Editorial changes.

19.4. WS-LC-0025, Revision 3.0, Effective 04/13/2018

19.4.1. Section 1.1 updated table with PFPeS and PFNS analytes.

19.4.2. Added Section 2.2, which details the analytes that can be covered by the method under special request.

19.4.3. Added Section 3.13, “AFFF: Aqueous Film Forming Foam”.

19.4.4. Section 6.19 added, “Create all eluents in Reagent module, label eluent containers with TALS label and place 2nd label into maintenance log when put into use” to table.

19.4.5. Section 7.1.2 added, “Prepared by weighing 1.509g of ammonium acetate and dissolving in 1L of water. The resultant solution is filtered through a 0.22um filter before use. This solution has volatile components, thus it should be replaced every 7 days or sooner.”

19.4.6. Section 7.1.3 added, “Prepared by diluting 12mL of ammonium hydroxide into 4L of methanol.”

19.4.7. Section 7.1.8 added, “Prepared by weighing 16g of potassium hydroxide and dissolving in 4L of methanol.”

19.4.8. Section 7.1.11 added, “Prepared by diluting 400mL of 1N NaOH into 3.6L of water for a total volume of 4L.”

19.4.9. Section 7.4 updated table with PFPeS and PFNS analytes.

19.4.10. Section 7.4, added table to detail ICAL for Fluorinated Replacement Compounds.

19.4.11. Added Section 8.1.1, “Water samples collected from a known chlorinated source should be preserved with Trizma.”

19.4.12. Added Section 9.9.3, “If the IS does not meet criteria, re-analyze the extract. If the IS meets criteria in the second analysis, report that analysis. If the IS does not meet criteria in the second analysis, report the first analysis with narration.”

19.4.13. Added Section 11.14.6, “Add 2g of potassium persulfate and 1.9 mL of 10N NaOH to each “Post” sample container.”

19.4.14. Removed Section 11.14.8, “Add 2g of potassium persulfate and 1.9 mL of 10N NaOH to each “Post” sample container.”

19.4.15. Added Section 11.14.9, “Cap each “Post” sample container, invert 2-3 times prior to placing container into water bath.”

19.4.16. Added Section 11.5 and associated subsections, which detail the “TOPS (Total Oxidizable Precursor) Assay for Soil Sample”.

19.4.17. Section 11.8 updated Table labeling, added PFPeS and PFNS analytes throughout Tables where applicable, and updated Table 7 to reflect current retention times and quantitation.

19.4.18. Section 11.8 added Table 6, “Recommended Instrument Operating Conditions Mass Spectrometer Scan Settings (SCIEX 5500) for Fluorinated Replacement Chemicals”

19.4.19. Section 11.18.3 removed outdated run sequence and replaced with current run sequence.

19.4.20. Editorial changes.

19.5. WS-LC-0025, Revision 2.9, Effective 11/22/2017

19.5.1. Section 1.2, table updated to reflect ranges after removing MeFOSA and EtFOSA from the SOP in the previous revision.

19.5.2. Section 9.3.6, last sentence changed to read, “Reprepare and reanalyze all field and QC samples associated with the contaminated method blank.”

19.5.3. Section 9.7, first sentence changed to read, “Initial calibration verification (ICV) – A second source standard is analyzed with the initial calibration curve.

19.5.4. Section 1.3.1 revised to read, “Once the optimal mass assignments (within ±0.5 amu of true) are made immediately following the initial tune, the lowest level standard from the initial calibration curve is assessed to ensure that a signal to noise ratio greater than 10 to 1 (S/N > 10:1) is achieved for each PFAS analyte. The first level standard from the initial calibration curve is used to evaluate the tune stability on an ongoing basis. The instrument mass windows are set initially at ± 0.5 amu of the true value; therefore, continued detection of the analyte transition with S/N > 10:1 serves as verification that the assigned mass remains within ± 0.5 amu of the true value, which meets the DoD/DOE QSM tune criterion. For QSM work, the instrument sensitivity check (section 10.12.4) is also evaluated to ensure that the signal to noise criteria is met.”

19.5.5. Editorial changes.

19.6. WS-LC-0025, Revision 2.8, Effective 11/06/2017

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

At this time only PFOS, PFOA and PFHxS are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.”

19.6.2. Sections 4.8 and 7.2.1.1, corrected the in-sample contributions to 0.30 ng/L and 0.015 ug/kg.

19.6.3. Removed Section 7.1.14, “Methanol-Water, 78:22 vol./vol., prepared by mixing 780 mL methanol and 220 mL reagent water. Stored in polypropylene bottle and sealed with polypropylene screw cap.” Reagent was added incorrectly.

19.6.4. Section 7.2.4, corrected the factor to 0.956 from 1.046.

19.6.5. Added Section 7.4.1, “A technical (qualitative) grade PFOA standard which contains both linear and branched isomers is used as a retention time (RT) marker. This is used to integrate the total response for both linear and branched isomers of PFOA in environmental samples while relying on the initial calibration with the linear isomer quantitative standard This technical (qualitative) grade PFOA standard is analyzed initially, after an initial calibration when a new column is installed or when significant changes are made to the HPLC parameters.”

19.6.6. Section 9.7, added “Rerun the initial calibration” as the last bullet item.

19.6.7. Added Section 10.3.1, “The first level standard from the initial calibration curve is used to evaluate the tune criteria. The instrument mass windows are set at ±0.5 amu; therefore, detection of the analyte serves as verification that the assigned mass is within ±0.5 amu of the true value, which meets the DoD/DOE QSM tune criterion.

19.6.8. Section 10.10.1, appended “containing both IDA and IS” to the end of the paragraph.

19.6.9. Sections 11.6.3 and 11.12.2.3, changed “78:22 methanol:water” to “methanol”.

19.6.10. Sections 1.1 and 7.4, removed EtFOSA and MeFOSA from tables due to low volume of requests for those analytes.

19.6.11. Removed Section 2.2.1, “Optional cleanups may include sample freezing and/or cleanup by SPE cartridge, unless EtFOSA and MeFOSA are requested.”

19.6.12. Removed EtFOSA/MeFOSA specific comments in various sections throughout the document.

19.6.13. Section 7.4 Note added, “The concentration of the calibration solutions for non-concentrated extracts is 1/20th the levels indicated above.”

19.6.14. Section 7.9, changed 1000 ng/mL to 250 ng/mL and replaced final sentence with "The internal standard solution used for the non-concentrated extracts is at a concentration of 50 ng/mL."

19.6.15. Removed Section 11.2.8, "If EtFOSA and/or MeFOSA are requested, add 100uL of IS and then adjust the final volume (FV) of these aliquots to 5.0 mL with MeOH. QC samples, LCS, MS, and MSD will require concentration via nitrogen to adjust the FV to 5.0 mL. Vortex each sample. Then, transfer a portion of the extract to a 300 uL polypropylene autosampler vial (7 drop-wise or approximately ½ filled is sufficient). Archive the rest of the extracts for re-injection and dilution."

19.6.16. Added Section 11.5.4, "Proceed to Section 11.15.2 (Graphitized Carbon Cleanup) as needed. This is required for all DoD/DOE extracts."

19.6.17. Added Section 11.7.1.1, "Seal the test tube tightly. Invert container several times and then vortex. Allow extract to settle for 10 minutes prior to moving to the next step."

19.6.18. Inserted Section 11.8.1.1, "Projects performed under the auspices of the DoD/DOE must have the entire sample homogenized prior to subsampling in accordance with QSM 5.1 criteria."

19.6.19. Section 11.11.4, added "(Graphitized Carbon Cleanup) as needed. This is required for all DoD/DOE extracts."

19.6.20. Section 11.14.6, added "Spike all "Pre" and "Post" samples with 25uL of the reverse surrogate solution (Section 7.8)."

19.6.21. Section 11.15.2, revised to read, "Cleanup with graphitized carbon will be applied to all samples as needed but is required for all DoD/DOE extracts."

19.6.22. Added Section 11.15.2.5, "Proceed to Section 11.6, 11.7, or 11.12 as applicable."

19.6.23. Removed Sections 11.15.3 through 11.15.6.

19.6.24. Added Section 11.16, "AFFF Sample Preparation".

19.6.25. Section 11.17, removed EtFOSA, MeFOSA, d5-EtFOSA, and d3MeFOSA from all tables.

19.6.26. Section 11.17, changed masses for M2-4:2FTS, M2-6:2FTS, and M2-8:2FTS. Initially assigned daughter masses were bleeding through from the native analog.

19.6.27. Section 11.17, all tables on MS Interface Mode Line, added "Minimum of 10 scans/peak."

19.6.28. Added Section 11.17.1, "Post Spike Sample Analysis for AFFF Samples".

19.6.29. Added Section 11.8.4.1 "Spike non-concentrated samples at 0.5 mL of LCS/Matrix Spike Solution."

19.6.30. Added Section 11.8.5.1, "Spike non-concentrated samples at 0.5 mL of IDA PFC Solution."

19.6.31. Editorial changes.

19.7. WS-LC-0025, Revision 2.7, Effective 09/20/2017

19.7.1. Section 1.1 table, added 1H,1H,2H,2H-perfluorohexane sulfonate *(4:2).*

19.7.2. Section 1.1, removed "Sample results for PFOA may also be reported as APFO, at the request of the client. (See Section 12.7)."

19.7.3. Section 1.2 and 11.8.2, updated tissue extracted mass and RL.

19.7.4. Section 2.5, removed "and assumes a proportional relationship between the initial calibration and the analyte in the extract. The ratio of the peak response to mass or concentration injected is used to prepare a calibration curve."

19.7.5. Added Section 6.6, "Extract concentrator or nitrogen manifold with water bath heating to 50-55°C".

19.7.6. Added Section 7.1.14, "Methanol-Water, 78:22 vol./vol., prepared by mixing 780 mL methanol and 220 mL reagent water. Stored in polypropylene bottle and sealed with polypropylene screw cap."

19.7.7. Section 7.2.1.1, revised "roughly 0.15 pg/L" to "roughly 0.15 ng/L".

19.7.8. Section 7.4 table, added:

4:2 FTS	0.5	1.0	2.0	20	50	200	400

19.7.9. Section 7.4 table, revised Labeled Isotope Dilution Analytes (IDA) Section.

19.7.10. Section 7.4 table, added:

Internal Standard (IS)							
13C2-PFOA	50	50	50	50	50	50	50

19.7.11. Section 7.4, removed "FOSAA may be added to the mix and are added at the same concentration as FOSA."

19.7.12. Added Section 7.9, "Internal Standard Solution, 1000 ng/mL. The internal standard solution is prepared by diluting 13C2-PFOA to produce a solution containing this compound at a concentration of 1000 ng/mL in methanol. This is added to all extracts prior to analysis. Non-concentrated extracts are fortified with a 5X dilution of this solution."

19.7.13. Section 8.1, changed "250 mL" to "8 oz."

19.7.14. Added Sections 9.3.6, 9.8.2.3, 10.10.4, 10.8.2.5, 10.11.3, and 10.12.4 to address DOD QSM 5.1 Table B-15 criteria.

19.7.15. Added Section 9.9, "Internal Standard."

19.7.16. Updated all tables to indicate target analyte quantitation via isotope dilution. Internal standard quantitation is only used to quantitate the IDA recoveries.

19.7.17. Added Section 10.8.2.4, 10.12.2, and 10.12.2.1 to incorporate IS criteria into calibrations.

19.7.18. Section 11.2.1, "Evaluate if the sample can be decanted or centrifuged; if not, contact the client for guidance. Filtering the sample can lead to a low bias."

19.7.19. Added Section 11.2.3.1, "Alternatively, weigh the sample container prior to extraction and then weigh the sample container after extraction to determine the initial volume."

19.7.20. Added Section 11.5.3, "Note: If the extracts will not be concentrated elute extract with a total of 8 mL of 0.3% NH_4OH/methanol."

19.7.21. Added Section 11.6.2.3, "Add 300 uL of the 78:22 methanol:water solution and mix the contents well using a vortex mixer."

19.7.22. Added Section 11.6.2.4, "Add 100 uL of Internal Standard (IS) solution to each extract and vortex to mix."

19.7.23. Added Section 11.7, "Final volume for non-concentrated extract".

19.7.24. Revised Section 11.11, "SPE Elution of Solid Extracts".

19.7.25. Revised Section 11.12, "Extract Concentration for Solid Samples".

19.7.26. Removed Section 12.8, "If results are to be reported as ammonium perfluorooctanoate (APFO), instead of PFOA, apply a multiplier of 1.0406 to the sample results to correct for the molecular weight differences between PFOA and APFO or this adjustment can be made during the preparation of the standards used for calibration. (Use one, not both.)"

19.7.27. Removed Section 13.4 – it was a copy of Section 13.2.

19.7.28. Various revisions to fulfill requirements based on DOD/DOE QSM 5.1.

19.7.29. Editorial changes.

19.8. WS-LC-0025, Revision 2.6, Effective 08/15/2017

19.8.1. Section 7.4, added MPFBS, MPFTeDA, and MPFHxDA to the table.

19.8.2. Section 11.15, added 13C-PFBS to the Recommended Instrument Operating Conditions table for SCIEX 5500.

19.8.3. Section 11.15 Recommended Instrument Operating Conditions table, changed the mass transitions for native PFTeDA from 713 > 669 (quant) and 713 > 169 (qualifier) to 713 > 169 (quant) and 713 > 219 (qualifier).

19.8.4. Editorial changes.

19.9. WS-LC-0025, Revision 2.5, Effective 07/10/2017

19.9.1. Revised Section 11.6.1 to read "Prior to concentrating each sample, add 100 uL of water."

19.9.2. Revised Section 11.6.2 to read "Concentrate each sample under a gentle stream of nitrogen until the methanol is evaporated and the 100 uL of water remains.

11.6.2.1 This blow down must take a minimum of 3.5 hours.

11.6.2.2 Extracts can not remain in the water bath longer than 5 minutes once concentrated."

19.9.3. Revised Section 11.6.3 to read "Add 400 uL of methanol to each extract, soak, and vortex to mix well. This will create an extract with a final solvent composition of 80:20 methanol:water."

19.9.4. Revised Section 11.11.1 to read "Prior to concentrating each sample, add 200 uL of water."

19.9.5. Revised Section 11.11.2 to read "Concentrate each sample under a gentle stream of nitrogen until the methanol is evaporated and the 200 uL of water remains."

11.11.2.1 This blow down must take a minimum of 3.5 hours.

11.11.2.2 Extracts can not remain in the water bath longer than 5 minutes once concentrated."

19.9.6. Revised Section 11.11.3 to read "Add 800 uL of methanol to each extract, soak, and vortex to mix well. This will create an extract with a final solvent composition of 80:20 methanol:water."

1. SCOPE AND APPLICATION

1.1. This procedure describes the analysis of water samples via in line solid phase extraction (SPE) for the following compounds using liquid chromatography / tandem mass spectrometry (LC/MS/MS) on a SCIEX 5500.

Compound Name	Abbreviation	CAS #
Perfluoroalkylcarboxylic acids (PFCAs)		
Perfluoro-n-heptanoic acid	PFHpA	375-85-9
Perfluoro-n-octanoic acid	PFOA	335-67-1
Perfluoro-n-nonanoic acid	PFNA	375-95-1
Perfluorinated sulfonic acids (PFSAs)		
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1

1.2. The working range of the method is listed below. The linear range can be extended by diluting the extracts.

Matrix	Nominal Sample Size	Reporting Limit	Working Range
Water	1.0 mL	2.0 ng/L	2 to 200 ng/L

2. SUMMARY OF METHOD

2.1. A 1 mL aliquot of sample is diluted to a 40:60 methanol:water extract and analyzed by LC/MS/MS. PFAS are separated from other components on a C18 column with a solvent gradient program using 20mM ammonium acetate/water and methanol.

3. DEFINITIONS

Refer to Section 3 of the main body of this SOP for a summary of definitions.

4. INTERFERENCES

Refer to Section 4 of the main body of this SOP for interferences.

5. SAFETY

Refer to Section 5 of the main body of this SOP for safety information.

6. EQUIPMENT AND SUPPLIES

Refer to Section 6 of the main body of this SOP for supplies, other than those listed below specific to the in line SPE analysis.

6.1. 2 mL auto sampler vials, clear glass, Thermo Scientific Nation surestop vial, part no. C5000-1, or equivalent.

6.2. Vial caps, Thermo Scientific National AVCS blue cap, pre slit TEF/STL septa, part no. C5000-55B or equivalent.

6.3. Eppendorf 1000 uL epTIPS, part no. 022491954 or equivalent.

6.4. Eppendorf 200 uL epTIPS, part no. 022491938 or equivalent.

6.5. 50 mL graduated plastic centrifuge tubes, SCP Science DigiTUBES part no. 010-500-263 or equivalent

6.6. 1000 uL Pipette: Eppendorf Research Plus

6.7. 100 uL Pipette: Rainin EDP3-Plus

6.8. 250 mL HDPE bottles with PPE screw caps, ESS part no. 0250-1902-QC or equivalent.

6.9. Analytical columns

6.9.1. Phenomenex Gemini C18 3 um, 3.0 mm x 100 mm, Part No. 00D-4439-Y0, or equivalent.

6.9.2. PFAS Isolator column, Phenomenex Luna C18 5 um, 50 mm x 4.6 mm, part no. 00B-4252-E 0 or equivalent.

6.10. SCIEX 5500 Triple Quad MS. The system utilizes Chrom Peak Review, version 2.1 or equivalent.

6.11. Shimadzu CTO-20AC HPLC equipped with 3 LC-20AD pumps and one DGU-20 degassing unit or equivalent.

7. REAGENTS AND STANDARDS

Refer to Section 7 of the main body of this SOP for reagents and standards, other than those listed below specific to the in line SPE analysis.

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

7.1.1. Ammonium acetate, Fisher Optima LCMS grade (20 mM in water), part no. A114-50, or equivalent.

7.1.2. Methanol, Baker HPLC grade, part no. 9093-03.

7.1.3. Water, Nanopure or Millipore or Fisher Optima LCMS grade, part no. W6-4, must be free of interference and target analytes.

7.2. Calibration Standards

The calibration stock solution is prepared by diluting the appropriate amounts of the stock solutions (Section 7.2 of the main body of this SOP) in 40:60 methanol:water. The calibration stock solution is diluted with methanol to produce initial calibration standards. These are the normal calibration levels used. A different range can be used if needed to achieve lower reporting limits or a higher linear range.

7.3. Initial Calibration (ICAL) Levels (ng/L)

Compound	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**	**CS-8**
Perfluoroalkylcarboxylic acids (PFCAs)								
PFHpA	1.0	2.0	5.0	10	20	50	100	200
PFOA	1.0	2.0	5.0	10	20	50	100	200
PFNA	1.0	2.0	5.0	10	20	50	100	200
Perfluorinated sulfonic acids (PFSAs)								
PFBS	1.0	2.0	5.0	10	20	50	100	200
PFHxS	1.0	2.0	5.0	10	20	50	100	200
PFOS	1.0	2.0	5.0	10	20	50	100	200
Labeled Isotope Dilution Analytes (IDA)								
13C4-PFHpA	50	50	50	50	50	50	50	50
13C4-PFOA	50	50	50	50	50	50	50	50
13C5-PFNA	50	50	50	50	50	50	50	50
18O2-PFHxS	50	50	50	50	50	50	50	50
13C4-PFOS	50	50	50	50	50	50	50	50

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

7.4. LCS/Matrix PFC Spike Solution, 100 ng/mL.

The PFC spike solution is prepared by diluting all PFAS to produce a solution containing each PFAS at 100 ng/mL in methanol.

7.5. PFC Isotope Dilution Analyte (IDA) Spike Solution, 1 ng/mL.

The PFC-IDA solution is prepared by diluting all labeled PFAS to produce a solution containing each at 1 ng/mL in methanol.

8. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

8.1. Water samples are collected in pre-cleaned 250 mL HDPE containers. Other containers may also be suitable. Samples are chilled to 0 - 6 °C for shipment to the laboratory.

8.2. Samples are logged in following normal laboratory procedures and are stored under refrigeration at 0 - 6 °C. Water samples must be analyzed within 28 days of collection.

9. QUALITY CONTROL

Refer to Section 9 of the main body of this SOP for Quality Control information.

9.1. If potable water samples from the state of New York (NY) are analyzed via this method the control limits for LCS and IDA for PFOS and PFOA recoveries are 70-130%. If these limits are not met, refer to Section 9 of the main body of this SOP for corrective action.

9.2. If POST (treatment) samples have positive detections, review the associated PRE and MID (treatment) samples for similar detections. Re-preparation and re-analysis may be needed.

9.3. If PFBS is detected in the method blank greater than the RL, evaluate data for impact. PFBS is a known laboratory artifact. Re-preparation and re-analysis may be needed.

10. CALIBRATION

Refer to Section 10 of the main body of the SOP for calibration information.

11. PROCEDURE

Refer to Section 11 of the main body of this SOP for procedures, other than those listed below specific to the in line SPE analysis.

11.1. Water Sample Preparation

11.1.1. Visually inspect samples for the presence of settled and or suspended sediment/particulate. Evaluate if the sample can be decanted or centrifuged; if not, contact the client for guidance. Filtering the sample can lead to a low bias.

If authorized by the client to filter the sample, filter the water sample through a glass fiber filter (Whatman GF/F Cat No 1825 090 or equivalent). Gravity of vacuum can be used to pass the sample through the filter. Prepare a filtration blank with any samples requiring filtration. File an NCM noting the need for filtration.

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

11.1.2. Prepare an LCS and method blank by adding 250 mL of HPLC grade water into a 250 mL HDPE bottle.

11.1.3. If requested, find the client assigned sample for MS/MSD.

11.1.4. Spike directly into the sample bottles for the LCS and MS/MSD (if requested) with 0.050 mL (50 uL) of the LCS/Matrix PFC Spike solution (Section 7.4). This will result in a sample concentration of 20 ng/L. Shake well to disperse spike.

11.1.5. Measure 1 mL of each sample using an Eppendorf pipette and pour into a labeled 2.0 mL injection vial. This includes the LCS and method blank samples as well.

11.1.6. Be sure to “prepare” the pipette by collecting two 1 mL aliquots and disposing of them, and then collect the aliquot for testing.

11.1.7. Add 83 uL of surrogate solution (PFC IDA Spike Solution, Section 7.5) into each vial for each sample and QC sample. This will result in an extract concentration of 50 ng/L for the surrogate.

11.1.8. Add 577 uL of methanol to each sample for a final solvent composition of 40:60 methanol:water.

11.1.9. Seal the vial with a polypropylene screw cap. Note: Teflon lined caps can not be used due to detection of low level concentration of PFAS.

11.1.10. Vortex to mix the mixture well.

11.2. Instrument Analysis

11.2.1. Suggested operation conditions are listed in Tables 1A-1C below:

Table 1A - Routine Instrument Operating Conditions					
HPLC Conditions (Shimadzu HPLC)					
Column (Column temp = 35°C)	Phenomenex Gemini C18 3 um, 3.0 mm x 100 mm				
Mobile Phase Composition	A = 20 mM Ammonium Acetate in Water B = Methanol				
Gradient Program	**Time (min)**	**%A**	**%B**	**Curve**	**Flow Rate (mL/min)**
	0	90	10	6	0.60
	1	90	10	6	0.60

Table 1A - Routine Instrument Operating Conditions					
HPLC Conditions (Shimadzu HPLC)					
	1.5	35	65	6	0.60
	8	5	95	6	0.60
	8.1	1	99	6	0.60
	12	1	99	6	0.60
	12.5	90	10	6	0.60
	Maximum Pressure limit = 5,000 psi				
Injection Size	950 uL (fixed amount throughout the sequence)				
Run Time	17.1 minutes				
MS Interface Mode	ESI Negative Ion. Minimum of 10 scans/peak.				
Ion Spray Voltage (kV)	4.5				
Entrance Potential (V)	5				
Declustering Potential (V)	25				
Desolvation Temp	550 ºC				
Curtain Gas (nitrogen) Flow	35 psi				
Collision Gas (nitrogen) Flow	8 psi				

Table 1B - Routine Instrument Operating Conditions						
Mass Spectrometer Scan Settings (SCIEX 5500)						
Compound	**Comments**	**Reaction (MRM)**	**Dwell (sec)**	**Ent. Pot. (V)**	**Col. Energy (V)**	**Declu. Pot. (V)**
PFBS	Perfluorobutanesulfonate	299 > 80	0.02	6	58	55
18O2-PFHxS	IDA	403 > 84	0.02	12	74	60
PFHpA	Perfluoroheptanoic acid	363 > 319	0.02	6	12	25
13C4-PFHpA	IDA	367 > 322	0.02	6	12	25
PFHxS	Perfluorohexanesulfonate	399 > 80	0.02	12	74	60
18O2-PFHxS	IDA	403 > 84	0.02	12	74	60
PFOA	Perfluorooctanoic acid	413 > 369	0.02	6	14	25
13C4PFOA	IDA	417 > 372	0.02	6	14	25
PFNA	Perfluorononanoic acid	463 > 419	0.02	6	14	25
13C5-PFNA	IDA	468 > 423	0.02	6	14	25
PFOS	Perfluorooctanesulfonate	499 > 80	0.02	9	108	65
13C4-PFOS	IDA	503 > 80	0.02	9	108	65

Table 1C				
Native Compounds	**Typical Native RT (minutes)**	**IS analog**	**Typical IDA RT (minutes)**	**Quantitation Method**
PFBS	6.68	18O2-PFHxS	7.76	Isotope Dilution
PFHpA	7.77	13C4-PFHpA	7.77	Isotope Dilution

Table 1C

Native Compounds	Typical Native RT (minutes)	IS analog	Typical IDA RT (minutes)	Quantitation Method
PFHxS	7.76	18O2-PFHxS	7.76	Isotope Dilution
PFOA	8.44	13C4-PFOA	8.44	Isotope Dilution
PFNA	9.10	13C5-PFNA	9.10	Isotope Dilution
PFOS	9.06	13C4-PFOS	9.06	Isotope Dilution

11.2.2. Tune and calibrate the instrument as described in Section 10.

11.2.3. A typical run sequence is as follows:

- Primer (A number of primers are injected for conditioning of the instrument before analysis, especially when the instrument was idled or changed from a different analysis).
- Blank
- Calibration Curve
- ICB
- ICV
- PFOA RT marker (as needed)
- Rinse Blank (RB, not linked to anything)
- MB
- LCS
- LCSD (if applicable)
- Sample 1
- Sample 1 MS (if applicable)
- Sample 1 MSD (if applicable)
- Sample 2 (up to sample 10 before next CCV)
- CCV
- Up to 10 samples.
- End sequence with CCV

12. CALCULATIONS

Refer to Section 12 of the main body of this SOP for calculation information.

13. METHOD PERFORMANCE

Refer to Section 13 of the main body of this SOP for method performance information.

14. POLLUTION PREVENTION

Refer to Section 14 of the main body of this SOP for pollution prevention information.

15. WASTE MANAGEMENT

Refer to Section 15 of the main body of this SOP for waste management information.

16. REFERENCES

Refer to Section 16 of the main body of this SOP for reference information.

17. METHOD MODIFICATIONS

17.1. Refer to Section 17 of the main body of this SOP for modifications from Method 537, except as detailed below:

17.1.1. Water samples are prepared at 1.0 mL, not 250 mL.

17.1.2. Water sample containers are not preserved with Trizma. Holding time has been changed to 28 days for analysis.

17.1.3. The eluents and HPLC configuration differs. As a result the final extract is in 40:60 methanol:water.

18. ATTACHMENTS

There are no attachments to this Appendix.

19. REVISION HISTORY

Revisions prior to 04/10/2017 have been removed and are available in previous versions of this SOP.

19.1. WS-LC-0025, Attachment 1, Revision 3.0, Effective 04/13/2018

19.1.1. Updated labeling and formatting of Tables 1A-1C.

19.1.2. Added section 11.2.3, detailing a typical run sequence.

19.2. WS-LC-0025, Attachment 1, Revision 2.9, Effective 11/27/2017

19.2.1. No changes to the attachment with this revision.

19.3. WS-LC-0025, Attachment 1, Revision 2.8, Effective 11/06/2017

19.3.1. Section 11.2.1, Routine Instrument Operating Conditions table (SCIEX 5500), added “Minimum of 10 scans/peak”.

19.4. WS-LC-0025, Attachment 1, Revision 2.7, Effective 09/22/2017

19.4.1. Section 6.5, removed “The 5 items above are to be maintained in the drawer labeled “Segregated Supplies for in line SPE Analysis” in the LC/MS instrument room.”

19.4.2. Added Sections 9.1 – 9.3.

19.4.3. Updated Section 11.1.

19.4.4. Editorial changes.

19.5. WS-LC-0025 Attachment 1, Revision 2.6, Effective 08/11/2017

19.5.1. No revisions to this attachment.

19.6. WS-LC-0025 Attachment 1, Revision 2.5, Effective 07/10/2017

19.6.1. No revisions to this attachment.

19.7. WS-LC-0025 Attachment 1, Revision 2.4, Effective 04/25/2017

19.7.1. No revisions to this attachment.

19.8. WS-LC-0025 Attachment 1, Revision 2.3, Effective 04/10/2017

19.8.1. Changed all mentions of “direct aqueous injection (DAI)” to “in line solid phase extraction (SPE).”

19.8.2. Inserted Section 17.1, and changed formatting of the modifications to Method 537 to Section 17.2 and subheadings.

Title: Determination of VOCs in Ambient Air
EPA Compendium Methods TO15, & TO3

Approval Signatures:

Don Dawicki Laboratory Director	Bill Desjardins Department Supervisor
Luke Orchard Quality Assurance Manager	Mathew Kirk Operations Mgr./EHS Coordinator

Facility Distribution No. Electronic **Distributed To: Facility Intranet**

The controlled copy of this SOP is the PDF copy of the SOP that is posted to the laboratory’s SOP Directory. Printed copies of this SOP or electronic copies of this SOP distributed outside the facility are considered uncontrolled.

1.0 Scope and Application

This SOP describes the laboratory procedure for the analysis of polar and non-polar volatile organic compounds (VOCs) in ambient and non-ambient air. The procedure is applicable to those VOCs that have been evaluated by the laboratory for their consistent performance in meeting the control criteria put forth in Compendium Method TO-15. While the compendium method is specifically written for the analysis of ambient air samples collected in leak-free passivated stainless steel canisters, it may be applied to the analysis of samples that have employed the use of other collection devices such as Tedlar bags, and are from sources other than ambient air such as soil gas, landfill gas, gas cleaning apparatuses and stack emissions.

This procedure may be also be used to report a variety of carbon ranges, constituent groups like TVOC (total volatile organic compounds), or as unresolved complex mixtures (e.g. Total Hydrocarbons).

1.1 Analytes, Matrix(s), and Reporting Limits

The target compound list and reporting limits for each compound are provided in Table 1A and Table 1B.

2.0 Summary of Method

An aliquot of sample is pulled from the canister through a solid multi sorbent bed trap which reduces the water content of the sample. The sample is thermally desorbed and the VOCs are carried onto a GC column coupled to a mass spectrometer. Compounds are identified by comparison of the mass spectra for individual peaks in the total ion chromatogram to the fragmentation patterns of ions corresponding to VOCs including the intensity of primary and secondary ions as well as the patterns of stored spectra acquired under similar conditions. The concentration of the target compound is calculated by internal standard technique using the average response factor or slope and intercept of that compound as determined by the initial calibration.

This procedure is based on EPA Compendium Method TO-15 "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry", US EPA, January, 1999 and Method TO-3 “Method for the Determination of Volatile Organic Compounds In Ambient Air Using Cryogenic Pre Concentration Techniques and Gas Chromatography with Flame Ionization and Electron Capture Detection”, USEPA, April 1984.

If the laboratory has modified the method, a list of these modifications may be found in Section 16.0.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Contamination may occur if canisters or other equipment is not properly cleaned before use. The laboratory procedures for canister and flow controller cleaning are provided in SOP BR-AT-011.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The analytical system contains zones with elevated or depressed temperatures that are capable of causing injury upon direct contact. The analyst needs to be aware of the locations of those zones, and allow them to return to room temperature prior to maintenance activities or take measures to avoid contact with hot and/or cold surfaces. There are areas of high voltage in the analytical system. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power.

Liquid nitrogen (LN_2) is used for cryogenic purposes. In addition to avoiding contact with LN_2 cooled surfaces, analysts must be aware of the potential for oxygen depletion in a confined space in the event of an unexpected large release of the product. Users should evacuate a confined space in which large amounts of LN_2 have been released.

Sample canisters are occasionally pressurized for cleaning or sample dilution purposes. Lab systems are designed to ensure that the cans are not pressurized above 40 psi. Eye protection must be worn when cans are pressurized in the event of a canister failure.

5.2 Primary Materials Used

There are no materials used in this method which have a serious or significant hazard rating
NOTE: This list does not include all materials used in the method. A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

6.0 Equipment and Supplies

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment meets the specification of this SOP.

6.1 Sampling Equipment

- 6L and 1L SUMMA® Canisters: Leak-Free, Passivated Stainless Steel, with Swagelok DSS4 Valves, or equivalent. Maximum rated pressure 40 psig.
- 6L SUMMA® Canisters: Silicon lined-Leak-Free, Passivated Stainless Steel, with Swagelok DSS4 valves or equivalent. Maximum rated pressure 40 psig.
- Flow Controllers: Restek Catalog #24239 or equivalent.
- Flow Controller Orifice: Various sizes ranging from 0.008” to 0.060”, Restek or equivalent.
- Flow Controller Vacuum Gauges: Capable of measuring vacuum to an absolute vacuum of -30” of HG, and pressure up to 30 psi, Grainger Catalog #5WZ37 or equivalent
- Rain Guard: Stainless Steel Tubing ¼”, 10ft. Grainger or Equivalent. Cut 8” and bend into a J shape using a pipe bender.
- Stainless Steel Pre-Filter (7 um): Swagelok Catalog# SS-4F-T7-7 or equivalent
- Teflon Tape: Home Depot Brand or equivalent.

6.2 Analytical System

- Mass Spectrometer: Agilent 5973, 5975 MSD or equivalent.
- Gas Chromatograph: Agilent 6890, 7890, or equivalent.
- VOC Autosampler: Entech 7016CA or equivalent.
- Cryogenic Concentrator: Equipped with an electronic mass flow controller that maintains a constant flow for carrier gas and sample over a range of 0-200 cc/min. Entech 7100A, 7200, or equivalent.
- Low Pressure Liquid Nitrogen: Air Gas or equivalent.
- Glass Bead Cryotrap: Capable of effectively removing water while trapping polar and non-polar compounds. Entech catalog# 01-04-11320.
- TENAX Sorbent Trap: Capable of removing CO2 and trapping the polar and non-polar compounds. Entech catalog # 01-04-11330.Primary Column: Fused silica capillary column (60 m x 0.32 mm x 1.8 µm), Restek RTX-624 or equivalent.
- Data System: PC software for Entech instrumentation. Hewlett-Packard ChemStation data acquisition software, TestAmerica Chrom and TestAmerica LIMS (TALS).
- NIST Mass Spectral Library and Search Program, 2014 release or newer

6.3 Cleaning System

- Canister Cleaner Module and Software: Capable of filling canisters with humidified air and evacuating canisters to 50 mtorr, Entech Model 3100A or equivalent.
- Vacuum Pump: Capable of evacuating sample canisters to full vacuum. Vacuubrand or equivalent.
- Cleaning Manifold: Equipped with stainless steel and Teflon transfer lines and connections for cleaning up to twelve canisters simultaneously.
- Heating Belts: Individual thermal-stated heating belts used to heat canisters to 100ºC during the manifolds cleaning cycles. Entech or equivalent.
- Cleaning oven: Capable of cleaning 6 Summa Cans simultaneously at a temperature of 100ºC. Entech or equivalent.
- Flow Controller Cleaning Manifold: Capable of flushing hot Nitrogen through 24 flow controllers simultaneously for cleaning.

6.4 Miscellaneous Supplies

- Mass Flow Controller, NIST Traceable: Capable of flow rate of 70 mL/min, McMillan Company 80SD or equivalent. Use for the preparation of calibration and working standards.
- Syringes: Gas tight with a Luer-Lok tip, assorted sizes ranging from 1.0 mL to 1.0 L, SGE or equivalent.
- Digital Pressure Gauges, NIST Traceable: Capable of measuring pressure in the range of -30" Hg to 100 psi, Dwyer Models DPGA-12 and 67100 or equivalent
- Digital Flow Meter, NIST Traceable: Alltech or equivalent.
- Nitrogen Gas

7.0 Reagents and Standards

7.1 Reagents

Nitrogen- Gas off bulk Liquid Nitrogen tank. Air Gas or equivalent vendor

7.2 Standards

Purchase the following stock standard mixtures from commercial vendors:

- Mixed Gas Stock Standard: - Commercially prepared standard that includes internal standard and tune standard compounds: Bromofluorobenzene, Bromochloromethane, 1,4-Difluorobenzene, and Chlorobenzene-d5, at a concentration of 100 ppbv each. Spectra Gas or equivalent.
- Calibration Stock Standard: - Commercially prepared custom gaseous stock standard used by all network facilities that includes all target analytes at a concentration of 1.0 ppmv. Spectra Gases or equivalent.
- Calibration Ethanol Neat Material. >99.5 %
- ICV / LCS Stock Standard: - Custom made gaseous stock standard prepared from a different lot(s) of the source material(s) used to manufacture the calibration stock standard. The ICV/LCS stock standard includes all target analytes at a concentration of 1.0 ppmv. Spectra Gases.
- ICV/LCS Ethanol Neat material. >99.5% from a source other than the calibration source.

Prepare calibration and working standards mixtures by diluting a known volume of the stock standard with ultra pure zero air to a specified volume into a humidified summa canister. The summa canister is humidified by adding 100ul of VOA free reagent water. The volume of the standard added to the canister is calculated using the set flow rate of 70mL/min using a mass flow meter multiplied by the time of the standard addition, plus the inclusion of the 25ml volume for the tubing connecting the mass flow meter to the summa canister. The formulations for standard preparation are provided in Appendix B along with recommended expiration dates and storage conditions.

Each stock standard is assigned a 1 year expiration date from manufacture and recertified annually. See BR-QA-002 for details on the recertification process. The ethanol neat material is assigned the expiration date given by the manufacturer.

Note: When entering the concentrations of source standards in TALS, use the Requested concentration of source standards only if reported concentration is within +/-5% of the requested concentration. If it is not, use the reported concentration in the TALS reagent module.

If a new standard can not be received prior to the expiration of the standard presently in use, the lab will notify the QA manager. The QA manager will perform a control chart review (see SOP BR-QA-013). If the standard is determined to be acceptable, the lab may assign a new expiration date of not more than 30 days from the date of the last data point in the control chart review. When the new standard ID is created in TALS, the COA and the Control Chart verifying the standards stability will be attached to the reagent ID.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform sample collection so these procedures are not included in this SOP. Sampling requirements may be found in the published reference method.

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time	Reference
Air	1L or 6L Passivated Summa Canister*	1L	NA	30 days from collection	EPA TO-15

*1 liter Tedlar bags are only provided upon client request, however clients are discouraged from using Tedlar bags due to the shortened holding time of 72 hours from collection.

All samples should be collected in passivated stainless steel canisters that have been certified clean prior to sampling. The laboratory will provide certified clean canisters to the client upon request. The procedures for clean canister certification are provided in Laboratory SOP BR-AT-011.

The laboratory can also provide flow controllers set to the appropriate flow rate for the sampling time required by the client.

The laboratory ships air canisters in custom made boxes. The boxes are equipped with custom-made foam inserts to hold the pre-set flow-controllers. The shipping materials are designed to prevent damage of equipment to and from the sampling site. The laboratory checks the equipment to ensure it is in proper working order before shipment to the client and additional checks are performed on return of the equipment to the laboratory. Sampling instructions are provided with each sampling kit. The sampling crew is advised to handle the sampling equipment using the instructions provided by the laboratory to ensure optimum performance.

The laboratory’s sample acceptance policy for air samples in canisters requires that the sampling crew record the ID of the flow controller used for sample collection on the tag attached to each canister, but the association may also be recorded on the Field Test Data Sheet or a COC. With this information the laboratory can review the history of use of the FC as needed to troubleshoot potential equipment problems. Without the association, the history of use of the FC is unknown. The laboratory strongly recommends that field samplers be instructed to provide this information for each sampling event.

The return pressure of each canister should be between -10” Hg to -1”Hg, except for “grab” samples or samples with a collection rate of 100 or 200 mL/min, which must have a pressure greater than or equal to -10” Hg. The residual vacuum criteria ensure that the sample was collected over the time period the flow controller was calibrated for.

9.0 Quality Control

9.1 Sample QC

The following quality control samples are prepared with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 3
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 3
Internal Standard (ISTD)	Every Sample	See Table 3
Laboratory Control Sample Duplicate (LCSD)	Client request or if insufficient sample for Sample Duplicate	See Table 3
Sample Duplicate (SD)	1 in 20 or fewer samples	See Table 3
Trip Blank (TB)	Client Request	See Table 3

NOTE: The compendium reference method does not require the analysis of a laboratory control sample (LCS) or provide criteria for the evaluation of an LCS. The laboratory performs an LCS at the above mentioned frequency as an evaluation of percent recovery in a blank matrix. The laboratory uses statistically derived control limits for the LCS.

Unless otherwise specified by the client during project initiation, the LCSD will be used to measure precision only. The LCS will be used for evaluations for percent recovery and to determine if corrective action is necessary.

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Tune Standard (BFB)	Each Analytical Window	See Section 10.0
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Section 10.0
Initial Calibration Verification (ICV)	Once, after each ICAL	See Section 10.0
RT Window Establishment	Once per ICAL	See Section 10.0
Relative Retention Time (RRT)	With each sample	See Section 10.0
Continuing Calibration Verification (CCV)	Daily, after each BFB	See Section 10.0

10.0 Procedure

10.1 Support Equipment Calibration

Verify the calibration of the mass flow controller used to prepare standards, the calibration of the digital flow meter used to set and check the flow rates of the FC(s) used for sample collection, the calibration of the digital pressure gauges used to check return canister pressure, and the calibration of the stop watch used to measure standard addition time is current to the year. Immediately notify the QA department if the calibration is not current and wait for further instruction. Equipment whose calibration has expired may not be used without documented approval from the QA department.

NOTE: The QA department schedules the annual calibrations of the support equipment and maintains all Certificates of Calibration. The flow controllers are checked against a NIST traceable standard. This check is performed by the manufacturer of the equipment, when possible, or by an approved vendor that provides certification service.

10.2 Instrument Calibration

10.2.1 Tune Standard

Analyze a tune standard (BFB) prior at the beginning of each analytical window. The tune standard is a commercially prepared mixed gas stock standard that includes bromofluorobenzene (BFB) at a concentration of 100 ppbv.

To analyze the tune standard:

1) Establish the instrument operating conditions specified in Section 10.4.1.

2) Attach the mixed gas stock standard to the Entech concentrator by attaching the cylinder to the line dedicated for introduction of the internal standard (ISTD). The concentrator directly injects 20 mL of the 100 ppbv stock standard onto the instrument to yield an on column concentration of 10 ppbv.

3) Acquire the data and evaluate the results against the acceptance criteria given in Table 2. Criteria must be met prior to further analysis. The official start time of the 24 hour analytical window is the injection time of a passing tune standard. All samples must be injected within 24 hours of that time.

NOTE: The data processing system averages three scans (apex scan, scan prior, and scan following) and performs background subtraction of the single scan prior to the elution of BFB.

10.2.2 Initial Calibration (ICAL)

The instrument must be calibrated with a minimum of five calibration standards for each target analyte at concentrations that span the working range of the method.

The laboratory routinely analyzes 8 standards at the recommended concentrations of 0.035, 0.20, 0.50, 5.0, 10.0, 15.0, 20 and 40 ppbv, except for Ethanol. For Ethanol, a 6 point curve is analyzed at the following concentrations: 5, 10, 15, 20, 40, and 100 ppbv. Even though eight calibration standards are routinely analyzed not every calibration standard is used for each analyte. Each analyte has been assigned to an analyte group that includes a calibration range of at least five standards. The analyte group associations for each target analyte are provided in Table 1A and Table 1B. The calibration range for each analyte group is as follows:

- Group A: This analyte group is associated with a seven point calibration curve. The calibration range is 0.20 to 40 ppbv with the 0.035 ppbv standard excluded. The limit of quantitation (LOQ) for this group of analytes is 0.20 ppbv

- Group B: This analyte group is associated with a six point calibration curve. The calibration range is 0.50 to 40 ppbv with the 0.04 and 0.20ppbv standards excluded. The limit of quantitation (LOQ) for this group of analytes is 0.50 ppbv.

- Group C: This analyte group is associated with a five point calibration curve. The calibration range is 5.0 to 40 ppbv with the 0.04, 0.20, and 0.50ppbv standards excluded. The limit of quantitation (LOQ) for this group of analytes is 5.0 ppbv.

- Group D: This analyte group is an eight point calibration curve. The calibration range is 0.04 to 40 ppbv. The limit of quantitation (LOQ) for this group of analytes is 0.04 ppbv.

- Group E: (Ethanol): This analyte has a six point calibration curve. The calibration range is 5 to 100 ppbv. The limit of quantitation (LOQ) for this analyte is 5 ppbv.

Prepare the calibration standards using the formulations provided in Appendix B.

Analyze the standards in a sequence from lowest to highest concentration using the instructions provided in Section 10.4.2.

The data processing system calculates a relative response factor (RRF), for each analyte and isomer pair using the assigned internal standard. The internal standard associations for each target analyte are provided in Table 1A and 1B. The data processing system also calculates a mean relative response factor, relative standard deviation (RSD), relative retention time (RRT) and the mean RRT.

The following criteria must be met for a calibration to be considered acceptable:

- The RSD for each target analyte must be <30% with at most 2 exceptions up to a limit of 40%**.**

If linear regression is used the R2 must be greater than 0.996

- The area response for the primary quantitation ion for the internal standard for each ICAL standard must be within 40% of the mean area response over the calibration range for each internal standard.

- The RRT for each target compound at each calibration level must be within 0.06 RRT units of the mean RRT for the compound. The retention time shift for each of the internal standards at each calibration level must be within 20 seconds of the mean retention time over the initial calibration range for each internal standard.

If these criteria are not met inspect the system for problems and perform corrective action. Recommended corrective actions are provided in Section 10.2.5 and in Table 3.

Repeat initial calibration whenever instrument operating conditions are changed, a new column is installed, when significant instrument maintenance has been performed, and when the result of the CCV indicate the calibration is no longer valid.

10.2.3 Second Source Calibration Verification (ICV)

Immediately following an acceptable initial calibration verify the accuracy of the calibration by the analysis of the second source calibration verification standard (ICV).

Prepare the ICV following the formulation provided in Appendix B.

Analyze the ICV following the instructions provided in Section 10.4.2.

The percent recovery (%R) for each target analyte must be within 70-130%. If criteria are not met, perform corrective action. Recommended corrective actions are provided in Table 3. If corrective action is not successful, remake your standards and recalibrate.

If after successful analysis of the ICV, time remains in the 24-hour analytical window, QC and field samples may be analyzed without analysis of a continuing calibration verification check standard. If time does not remain in the analytical window, a new analytical sequence must be initiated with a Tune Standard followed by daily calibration (CCV).

10.2.4 Continuing Calibration Verification (CCV)

Analyze the CCV immediately after the tune standard unless the analytical window includes ICAL, in which case, a CCV is not required.

Prepare the CCV standard using the formulation given in Appendix B. The recommended concentration of the CCV for each target analyte is 10.0 ppbv.

Analyze the CCV following the instructions provided in Section 10.4.2. The data system calculates a response factor for each analyte and calculates the percent difference (%D) of the RRF relative to the mean RRF in the most recent initial calibration.

- The %D for each target analyte must be within ±30%. If the above criteria are not met, repeat the analysis of the CCV once. If the second CCV meets criteria, continue with the analytical sequence. If it fails, evaluate the data to determine if one of the following conditions is met. If these conditions are not met corrective action must be taken. Guidance for troubleshooting is provided in Section 10.2.5. After corrective action the analytical sequence may be continued only if two immediate, consecutive CCVs at different concentrations are within acceptance criteria. If these two CCVs do not meet the criteria, recalibration is required prior to further analysis.
- DoD QSM 5.1 requires that the closing CCV recover within ±30%. EPA Methods TO-14 and TO-15 do not include a closing CCV requirement, but they do have an opening CCV with a +/- 30% limit. If these criteria are not met, immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) until a passing CCV is attained, and then reanalyze all associated samples since last acceptable CCV. If necessary, perform a new initial calibration and then reanalyze all associated samples since the last acceptable CCV. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative.

Note: Per DoD QSM5.1, if samples cannot be re-analyzed, the data MUST be qualified with a Q flag and an explanation must be provided in the case narrative. With client permission, closing CCV criteria of 50% can be utilized.

- If the CCV criteria are exceeded high, indicating a high bias, and the associated samples have non-detects for those analytes, the analytical data may be considered usable. In the absence of instructions otherwise, proceed with analysis.

- If the CCV criteria are exceeded low, indicating a low bias, analytical results may be reported if those results exceed the project's regulatory decision level. In other words, if the analytical results are sufficiently high to counter the low bias, results may be reported. Consult with the project manager to determine if the exception is allowable for each project.

10.2.5 Troubleshooting

Check the following items in case of calibration failures:

- Loss of sensitivity or unstable ISTD recoveries are usually the result of a leak. Check the union between the GC column and Entech transfer line.

- Loss of sensitivity for individual compounds may be a result of either an active site in a transfer line or a bad trap. Troubleshoot and perform maintenance as necessary.

- Poor chromatography usually requires GC column maintenance, perform as necessary.

- Carryover is usually caused by excessive amounts of analyte introduced to the system. Analyze blanks until the system is cleaned or replace the traps and transfer lines if necessary.

Refer to corporate policy CA-Q-S-005 for additional information of procedures to establish and troubleshoot initial calibration curves.

10.3 Sample Preparation

10.3.1 Post Sampling Canister Pressure Check Procedure

The post-sampling canister pressure check is performed at the time of sample login by sample management staff so that any problems found are quickly identified and communicated to the client.

Refer to the current version of SOP BR-SM-001 for the procedure to take and record the post sampling canister pressure check.

10.3.2 Sample Screening

At the laboratory's discretion unknown samples may be screened prior to initial analysis to determine if the sample requires dilution. Unless otherwise requested by the client the laboratory does not provide screen data with the data package report even when primary dilutions are performed based on the results of the screen analysis.

To prepare a sample for screen analysis, connect the sample canister to the autosampler connected to screening instrument and analyze 20 mL of sample. Acquire and evaluate the results. If the results of screen analysis indicate that a target compound is above its upper range of calibration, calculate a recommended dilution factor (DF) by dividing the concentration of analyte found by 30. Record the recommended DF on the screen worksheet.

NOTE: Samples are screened on a GC/MS instrument that is programmed with the operating conditions given in Section 10.4.1 of this SOP. The calibration is checked weekly with a single point calibration standard at a concentration of 10 ppbv for all target analytes. The calibration is checked more frequently when the results of instrument analysis do not correlate well with the results of the screen analysis.

10.3.3 Sample Dilutions & Pressure Adjustment

Field samples should be diluted prior to initial analysis when the screen results indicate that the concentrations are above calibration range or when the laboratory has sufficient knowledge of the sample (history) to know that the sample will require dilution. Field samples must be reanalyzed at a dilution when the concentration of target compounds in initial analysis exceed of the upper range of calibration.

When the return negative pressure of a canister is greater than -10”Hg, make-up gas may be added to provide sufficient volume of make-up gas in order to have an adequate sample volume for analysis. The addition of make-up gas is considered a canister dilution. Some concentrators are able to pull full sample volume even if the residual vacuum is lower than -10”Hg so make-up air may not be necessary.

For samples analyzed for constituent groups (e.g. TVOC as Toluene), ranges, and or unresolved complex mixtures (Total Hydrocarbons), samples must be diluted such that the maximum peak height of any sample constituent under consideration does not exceed the equivalent peak height generated by highest calibration level standard. For evaluation it may be useful to graphically overlay sample chromatograms with that of the high point calibration standard.

To dilute the sample:

1) Attach the sample canister to the nitrogen gas line equipped with a pressure gauge that reads negative pressure in (“Hg) and positive pressure in (psig).

2) Ensure the valve of the nitrogen gas line is closed then open the valve of the sample canister. Record the negative pressure reading in the Canister Dilution Worksheet or on the canister’s tag.

3) Slowly open the valve of the nitrogen gas line and fill the canister until canister pressure gauge reads -10”Hg. Do not open the valve to such an extent that the nitrogen gas line pressure drops below 15 psig and do not allow the nitrogen gas line to reach equilibrium otherwise you will contaminate the nitrogen gas line.

4) When the desired pressure is achieved, close the canister valve and the valve on the nitrogen gas line; wait 15 seconds. The pressure should not exceed 40 psig.

5) Open the canister valve and record the final pressure reading in psig.

6) Close the canister valve and remove the valve from the zero air line.

7) Record the initial and final pressure readings in the TALS canister dilution tracking module. If the final pressure is below ambient, the "HG reading must be converted to psig by dividing the value by 2 prior to entry into the TALS worksheet.

When the return pressure of a canister is positive, the pressure must be adjusted to near ambient (0"Hg) prior to analysis. To adjust the pressure to ambient, vent the canister to ambient in a fume hood by opening the canister value for ~4-5 seconds, close the valve. For higher pressure canisters, open the valve and listen for a release of air then close the valve when the sound recedes.

If a trip blank is provided, pressurize the trip blank canister to 10 psig. The pressurization of the trip blank is not considered a dilution.

10.3.4 QC Sample Preparation

To prepare the method blank (MB): Fill a clean canister that has never been used to collect environmental samples and has never left the laboratory to 20 psig with nitrogen gas. Continue to use this canister as the MB until the pressure of the canister reaches 0 psig, at which time, recharge with nitrogen gas to 20 psig and reuse.

To prepare the LCS: Follow the instructions provided in Appendix B for preparation of the working ICV/LCS standard. If an LCSD is requested, analyze the LCSD from the same canister as the LCS.

10.4 Sample Analysis

10.4.1 Instrument Operating Conditions

Optimize the GC and MS conditions for compound separation and sensitivity.

The recommended operating conditions are as follows:

Thermal Desorb:
Initial Trap #1 Temperature: -110ºC
Desorb Temperature from Trap #1 to #2: 0 ºC
Total Volume Transfer by Mass Flow Controller: 40 mL
Initial Trap #2 Temperature: -15 ºC
Desorb Temperature from Trap #2 to #3: 200ºC
Transfer time 3.5 minutes
Initial Trap #3 Temperature: -165 ºC
Injection Trap #3 Temperature: 70ºC
Injection Time: 1.5 minutes
Trap #3 Temperature after Injection: -165 ºC

Carrier Gas:	Helium, Ultra High Purity
Cryogenic Focusing Gas:	Liquid Nitrogen
Flow Rate:	~1.5 mL/min
Temperature Program:	Initial Temperature: 40ºC Initial Hold Time: 4 minutes Ramp1 Rate: 20ºC/min. to 200ºC. Ramp 2 Rate: 40ºC/min. to 220ºC Final Temperature: 220ºC Final Hold Time: 6.5 minutes
Electron Energy:	70 electron volts
Mass Range:	35-265 amu
Scan Time:	≥1 scan per second

These operating conditions may be changed but once the operating conditions are established for initial calibration the same conditions must be used until a new calibration is performed.

10.4.2 Daily Instrument Maintenance

Prior to analysis initiate the flushing sequence using the Entech software. Then initiate the bake program using the Entech software.

10.4.3 Bi-Weekly Instrument Maintenance

At a minimum frequency of once every two weeks, perform an autosampler leak check. Cap all autosampler ports and initiate the leak check program using the Entech software. Record this check in the instrument maintenance log.

10.4.4 Analytical Sequence

An example analytical sequence that includes initial calibration (ICAL) is provided below. When ICAL is not performed, the sequence begins with the tune standard and is followed by the CCV, LCS, LCSD, and method blank. If sufficient time remains in the 24 hours analytical window after initial calibration, QC and field samples may be analyzed without the CCV and the ICV will serve as the LCS for the sequence. The MB, LCS and LSCD must be analyzed at a frequency of every 20 samples or with each analytical sequence whichever is more frequent.

1. Tune Standard (BFB)
2. ICAL
3. ICV
4. CCV
5. LCS (repeat every 20 samples)
6. LCSD (when requested)
7. MB (repeat every 20 samples)
8. Field Samples (including trip blanks)

Attach the canisters to the autosampler inlet in the order of the analytical sequence then initiate the analytical sequence. The autosampler introduces 200 mL of sample volume from each canister to the instrument system and adds 20 mL of the mixed gas standard to each sample.

Acquire the data and evaluate the results to confirm qualitative identification and quantification.

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

The data processing system tentatively identifies target analytes by comparing the retention time of the peaks to the window set around the continuing calibration standard, and searches in that area for the primary ion and up to two secondary ions characteristic of the target analyte.

All tentative identifications made by the computer are reviewed and either accepted or rejected by the primary analyst. The identification made by the system is accepted when the following criteria are met:

- The target analyte is identified by comparison of its background subtracted mass spectrum to a reference spectrum in the NIST14 database. In general, all ions that are present above 10% relative abundance in the mass spectrum of the standard should be present in the mass spectrum of the sample component and their relative abundances should agree within 20%. For example, if an ion has a relative abundance of 30% in the standard spectrum, its abundance in the sample spectrum should be in the range of 10-50%. Some ions, particularly the molecular ion, are of special importance if a tentative identification is to be made, and should be evaluated even if they are below 10% relative abundance.

- The GC retention time for the target analyte should be within 0.06 RRT units of the daily standard.

Identification requires expert judgment when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When GC peaks obviously represent more than one sample component (i.e., broadened peak with shoulder(s) or valley between two or more maxima), appropriate analyte spectra and background spectra can be selected by examining plots of characteristic ions for tentatively identified components. When analytes coelute (i.e., only one GC peak is apparent), the identification criteria can be met but each analyte spectrum will contain extraneous ions contributed by the coeluting compound. If the data system does not properly integrate a peak, perform manual integration. All manual integration must be performed and documented in accordance with corporate SOP CA-Q-S-002*Manual Integration*.

11.2 Quantification of Target Analytes

After a compound has been identified, the data system quantifies the on-column concentration of the target compound based on the integrated abundance of the characteristic ion from the EICP. If there is matrix interference with the primary ion, a secondary ion may be used for quantification by calculating a mean RF factor for that ion and using that ion to quantify the analyte in the sample. When secondary ion calculations are required, include this information in the non-conformance report and project narrative.

Samples analyzed for constituent groups, ranges, and or unresolved complex mixtures are quantified as follows;

11.2.1 TVOC as Toluene

An internal standard type quantification response factor is generated using the RIC peak response measured for Toluene and its associated internal standard (as detailed in the calculation section). That response factor is used to quantify all RIC chromatographic sample response with the exception of those peak responses associated with internal standards. The results are reported as ‘TVOC (as Toluene)’.

Retention Time Range: Propene to Naphthalene

11.2.2 GRO as Octane

An internal standard type quantification response factor is generated using the RIC peak response measured for Octane and its associated internal standard (as detailed in the calculation section). That response factor is used to quantify all RIC chromatographic sample response with the exception of those peak responses associated with internal standards that eluted within the retention time range as defined by the elution of 2-Methyl-Butane through Decane (C5-C10). The results are reported as ‘GRO (as Octane).

Retention Time Range: 2-Methyl-Butane to n-Decane

11.2.3 Unresolved Complex mixtures

An internal standard type quantification response factor is generated using the RIC peak response measured for the un-resolved complex mixture (i.e. the gasoline envelope) and its associated internal standard (as detailed in the calculation section). That response factor is used to quantify all similarly chromatographing RIC sample response with the exception of those peak responses associated with internal standards. The results are reported using the name of the unresolved complex mixture used in the calibration (e.g. Total Hydrocarbons).

Retention Time Range: Propene to Naphthalene

Final results are calculated in TALS.

11.3 Calculations

Analytical results are calculated as follows:

- **Dilution Factor**

$$DF = \frac{V_2}{V_1} x \frac{V_4}{V_3}$$

Where:
V_1 = Pre-Dilution Canister Volume

V_2 = Post-Dilution Canister Volume
V_3 = Sample Amount (mL)
V_4 = Base Sample Amount (200 mL)

Relative Response Factor (RRF)

$$RRF = \frac{(A_x)(C_{is})}{(A_{is})(C_x)}$$

Where:
A_x = Area of the quantitation ion of the analyte
A_{is} = Area of the quantitation ion of the internal standard
C_x = Concentration of analyte in concentration units (ppbv)
C_{is} = Concentration of internal standard in concentration units (ppbv)

- **Percent Relative Standard Deviation (%RSD)**

$$\%RSD = \frac{SD}{Mean} x100$$

Where:
SD = Standard deviation individual response factors
Mean = Average of five response factors

- **Sample Concentration**

$$C_x = \frac{(A_x)(C_{IS})}{(A_{IS})(\overline{RRF})}(DF)$$

Where:
C_x = Compound concentration (ppbv)
C_{IS} = Concentration of associated internal standard (ppbv)
A_{IS} = Area of quantitation ion for associated internal standard
A_x = Area of quantitation ion for compound
DF = Dilution Factor
Mean RRF = Average Relative Response Factor from initial calibration.

- **Unit Conversion from ppbv to ugm3**

$$\text{Analytical Result (ug/m3)} = \text{Result(ppbv)} \times \left(\frac{mw}{24.45}\right)$$

Where:
mw = molecular Weight

Example:
Benzene Result = 56 ppbv

Benzene mw = 78.108

$$\text{Analytical Result (ug/m3)} = 56\ \text{ppbv} \times \left(\frac{78.108}{24.45}\right)$$

Result(ug/m3) = 178.9 ug/m3 reported as 180 ug/m3

- **Percent Recovery (%R)**

$$\%R = \frac{C_s}{C_n} \times 100\%$$

Where:
C_s = Concentration of the spiked sample (ppbv)
C_n = Nominal concentration of spike added (ppbv)

- **Precision (%RPD)**

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured concentration of the first sample aliquot
C_2 = Measured concentration of the second sample aliquot

Formula of Standard Addition:

Volume (mL) = (FR x T) + 25 mL

Where:
FR = flow rate in mL/min
T= time in minutes

Example FR = 70ml/min
Time = 10.69 minutes
Volume = 25+ (70 x 10.69) = 773 mL

Total Volume of diluted standard

Volume (mL) = CV x P

Where:
CV = canister volume in mL
P = pressure in Bar (14.7psi per Bar)

Example: CV = 6185 mL
P= 2.5 Bar

Volume = 15462 mL

11.4 Data Review

11.4.1 Primary Review (Performed by Primary Analyst)

Upload the data files to TALS. Enter batch editor information and add the standards and reagents to the TALS batch. Review the results against acceptance criteria. If acceptance criteria are not met, make arrangements to perform corrective action.
Check the results of samples analyzed immediately after high concentration samples for signs of carry-over. Reanalyze the sample if carry over is suspected.

Dilute and reanalyze samples whose results exceed the calibration range. The diluted analysis should result in a determination within the upper half of the calibration curve.

Set results to primary, secondary, acceptable or rejected as appropriate.

Verify corrective action was taken for all results not within acceptance criteria. If corrective action is not taken or was unsuccessful, record all instances where criteria are not met with a nonconformance memo (NCM). Be sure to provide explanation of your decision making in the internal comment section of the NCM. The internal comment section should list the reason the NCM is suspected, which action (if any) was taken and why and the outcome of the action taken.

Review project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Set the batch to 1st level review.

Record your review on the data review checklist.

11.4.2 Secondary Review (Performed by Peer Reviewer)

Review the project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements and verify project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Review records (these records include but are not limited to the Pre-Shipment Clean Canister Certification Report, Flow Controller Set Flow Rate and Leak Check Record, Field Test Data Sheets, and the Air Canister Return Pressure Check Record) associated with release and return of air sampling equipment to ensure all anomalies are properly recorded. Compare any problems noted in these documents with the analytical results and record any findings in the narrative note program or otherwise communicate your findings to the PM for inclusion in the project narrative.

Review the TALS batch editor to verify information is complete. Review the batch to verify that the procedures in this SOP were followed. If discrepancy is found, resolve the discrepancy and verify any modifications to the SOP are were approved and are properly documented.

Spot-check 15% of samples in the batch to verify quantitative and qualitative identification. If the samples are being analyzed under DoD methods 100% of data must be checked during secondary review.

If manual integrations were performed:

- Review each manual integration to verify that the integration is consistent and compliant with the requirements specified in corporate SOP CA-Q-S-002.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in corporate SOP CA-Q-S-002.

- Generate a "before" and "after" chromatogram for every manual integration performed on an instrument performance check standard (Tune, ICAL, ICV, CCV), QC sample (MB, LCS) and for any manual integration performed on any surrogate or internal standard in any field sample, if not already performed automatically by the software..
- Generate the Manual Integration Summary Report if not automatically generated by the software. Document your review of manual integrations on the summary report and obtain any review signatures of integrations performed during secondary review as required.

  If the reviewer disagrees with the integration performed by the primary analyst, the secondary data reviewer should not change the integration. Instead, he/she should consult with the primary analyst that performed the integration and both the reviewer and the primary analyst should agree the integration should be changed. If consensus between the primary analyst and the peer reviewer cannot be achieved; both should consult with the Technical Manager or department management for resolution. Any changes to the integration should be performed by the primary analyst. If it is necessary for the secondary reviewer to perform the manual integration because the primary analyst is out of the office; the integration made by the peer reviewer must be reviewed by another peer reviewer or by department management to verify the integration was performed and documented in compliance to SOP CA-Q-S-002. If the original analyst that performed the integration is out of the office, the data reviewer may consult with the Department Manager (DM), Department Supervisor (DS) or the Technical Manager (TM) to verify the change he/she thinks is needed is warranted and should be made.

Verify that the performance criteria for the QC items listed in Table 1A or 1B were met. If the results do not fall within the established limits verify that corrective actions were performed. If corrective action was not performed; verify the reason is provided and that the situation is properly documented with an NCM. Set samples to 2nd level review.

Run the QC checker and fix any problems found. Run and review the deliverable. Fix any problems found. When complete set the method chain to lab complete and forward any paperwork to report/project management.

Record second level review on the data review checklist.

11.4.3 TO15 Poor Performing analytes

NOTE: Statistically derived limits will be no wider than 50-150%R for poor performing compounds.

Compounds with a high boiling point which is beyond the range of typical gas compounds
- Dodecane
- 1,2,4-Trichlorobenzene
- Hexachlorobutadiene
- Naphthalene
- 1,2,3-Trichlorobenzene

The following compounds change how they act on the traps depending on the humidity of the standard
- 3-chloro-1-propene
- Bromoform

The following compounds are very polar and are linked to the water in the standard. Since we remove most of the water during the trapping process, a little change can produce a big result. For example removing 95% of the water instead of 94% of the water will have a negligible affect on non-polar compounds, but a 20% difference for polar compounds.
- Ethanol (made from neat material and is not part of the standard TO-15 calibration gas mix due to high reactivity
- Ethyl ether
- Acrolein
- Acetone
- Isopropyl alcohol
- 2-butanone
- Tetrahydrofuran
- 2-hexanone

11.5 Data Reporting

Report analytical results above the reporting limit (RL) as the value found. Report analytical results less than the RL, to the adjusted RL with a “U” data qualifier. If the data is to be reported to the method detection limit (MDL) the analytical results between the RL and the MDL are reported with an “estimated” footnote. Adjust the RL and MDL for sample dilution/concentration. The unadjusted RL for each target analyte is provided in Table 1A and 1B. For Method TO3 the laboratory does not report values below the reporting limit.

Data reporting and creation of the data deliverable is performed by TALS using the formatters set by the project manager during project initiation.

Electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014 Laboratory Records.

12.0 Method Performance

12.1 Method Detection Limit Study (MDL)

Perform a method detection limit (MDL) study at initial method set-up following the procedures specified in laboratory SOP BR-QA-005,

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and when there is a significant change in instrumentation or procedure.

Each analyst that performs the analytical procedure must complete an initial demonstration of capability (IDOC) prior to independent analysis of client samples. Each analyst must demonstrate on-going proficiency (ODOC) annually thereafter. DOC procedures are further described in the laboratory's quality system manual (QAM) and in the laboratory SOP for employee training.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for “Waste Management and Pollution Prevention.”

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001 *Hazardous Waste*.

The following waste streams are produced when this method is carried out:

- None

15.0 References / Cross-References

- EPA Compendium Method TO-15, "Determination of Volatile Organic Compounds in Ambient Air using Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry", US EPA, January, 1999.
- USEPA Compendium Method TO-3 "Method for the Determination of Volatile Organic Compounds In Ambient Air Using Cryogenic Pre Concentration Techniques and Gas Chromatography with Flame Ionization and Electron Capture Detection", USEPA, April 1984
- New Jersey Department of Environmental Protection Site Remediation Program Vapor Intrusion Technical Guidance, Version 3.1, March 2013.
- Laboratory SOP BR-QA-005, Procedures for the Determination of Limits of Detection (LOD), Limits of Quantitation (LOQ) and Reporting Limits (RL).
- Laboratory SOP BR-QA-011 Employee Training
- Laboratory SOP BR-EH-001 Hazardous Waste
- Laboratory SOP BR-QA-014 Laboratory Records
- Laboratory SOP BR-SM-001 Sample Management
- Laboratory SOP BR-AT-011 Canister Cleaning
- Laboratory Quality Assurance Manual (QAM)
- Corporate SOP CA-Q-S-002 *Manual Integration Practices*

16.0 Method Modifications

- This SOP utilizes and alternative detector (mass spectrometer) vs that of a FID and/or ECD as listed in the published method.
- This SOP describes a method where an aliquot of a whole air sample collected in a passivated stainless steel canister is cryogenically trapped and concentrated prior to injection into the MS detector equipped GC.
- This Method SOP utilizes an RTX-624 capillary column (60M x 0.32 mm ID x 0.18um).
- Additional quality control aspects are employed in the use of this method based on the alternative detector type, specifically, the detector tune is verified at the beginning of each period of analysis prior to the acquisition on any standard, blank, QC sample or field sample.
- This Method SOP does not utilize sub ambient column oven temperature programming.
- Sample traps consist of a multi bed system employing Tenax and glass beads (see manufactures system description: Entech Model 7100 Sample pre Concentrator).
- Sampling apparatus consists of passivated stainless steel canister specifically design for the collection of ambient air samples for volatile analysis
- Nafion dryers are not used. The analytical pre-concentration system employs a moisture control system consisting of multi sorbent bed traps.
- System calibration is verified every 24 hour within which samples are analyzed. System linearity is not verified every 4-6 hours as described.
- Published Method requires weekly multi-point calibration be performed. Laboratory performs multi-point calibrations as necessary see section 10.2
- System linearity is determined through multi point calibration utilizing average response factors and internal standard technique quantification (see Section 10).

17.0 Attachments

- Table 1A: Target Compound List, RL, Internal Standard and Ion Assignments for TO15
- Table 1B: Target Compound List, RL, Internal Standard and Ion Assignments for TO3
- Table 2: Ion Abundance Criteria (BFB)
- Table 3: QC Summary & Recommended Corrective Action
- Table 4: LCS Control Limits
- Appendix A: Terms and Definitions
- Appendix B: Standard Preparation Tables
- Appendix C: DoD QSM LCS and MS/MSD Limits

18.0 Revision History

Revision 13.0:
- Title Page: Updated copyright date and signatories.
- Added note to section 7.2 regarding requested vs. reported concentration of standards
- Section 10.2.2 added statement "**If linear regression is used the R2 must be greater than 0.996**"
- Added section 11.4.3 regarding poor performing compounds.
- Table 4: updated control limits based on historical data from 1/28/2018 through 1/28/2019.
- Section 11.5: added note regarding reporting between MDL and RL.
- Table 3: updated wording to match section 10.2.2 for ISTD criteria.

Previous revisions are retained by the QA department.

Table 1A: Routine Compound List, Reporting Limit, Internal Standard and Ion Assignments

Analyte	CAS No.	6L RL (ppbv)	1L RL (ppbv)	Quantifier Mass	Qualifier Mass	Qualifier Mass	ISTD Group	Analyte Group
Dichlorodifluoromethane	75-71-8	0.5	5	85	87		1	B
Freon-22	75-45-6	0.5	5	51	67	69	1	B
1,2-Dichlorotetrafluoroethane	76-14-2	0.2	2	85	135	87	1	A
Chloromethane	74-87-3	0.5	5	50	52		1	B
n-Butane	106-97-8	0.5	5	43	41	58	1	B
Vinyl Chloride	75-01-4	0.035	0.40	62	64		1	D
1,3-Butadiene	106-99-0	0.035	5	54			1	D
Bromomethane	74-83-9	0.2	2	94	96		1	A
Chloroethane	75-00-3	0.5	5	64	66		1	B
Isopentane	78-78-4	0.2	2	43	57	56	1	A
Bromoethene (Vinyl Bromide)	593-60-2	0.2	2	106	108	81	1	A
Trichlorofluoromethane	75-69-4	0.2	2	101	103		1	A
Pentane	109-66-0	0.5	5	43	57	72	1	B
EthylEther	60-29-7	0.2	2	59	45	74	1	A
Acrolein	107-02-8	5	50	56	55	37	1	C
Freon TF	76-13-1	0.2	2	101	151	103	1	A
1,1-Dichloroethene	75-35-4	0.035	2	96	61	63	1	A
Acetone	67-64-1	5	50	43	58		1	C
Isopropyl Alcohol	67-63-0	5	50	45	43		1	C
Carbon Disulfide	75-15-0	0.5	5	76			1	B
3-Chloropropene (Allyl Chloride)	107-05-1	0.5	5	41	76		1	B
Acetonitrile	75-05-8	5	50	41	40	39	1	C
Methylene Chloride	75-09-2	0.5	5	49	84	86	1	B
tert-Butyl Alcohol	75-65-0	5	50	59	41	43	1	C
Methyl tert-Butyl Ether	1634-04-4	0.5	5	73	43		1	B
trans-1,2-Dichloroethene	156-60-5	0.2	2	61	96		1	A
n-Hexane	110-54-3	0.5	5	57	86		1	B
1,1-Dichloroethane	75-34-3	0.035	2	63	65	83	1	A
Methyl Ethyl Ketone	78-93-3	0.5	5	72	43		1	B
cis-1,2-Dichloroethene	156-59-2	0.035	2	96	98		1	A
Tetrahydrofuran	109-99-9	5	50	42	72		2	C
Chloroform	67-66-3	0.2	2	83	85		1	A
1,1,1-Trichloroethane	71-55-6	0.2	2	97	99	61	2	A
Cyclohexane	110-82-7	0.2	2	84	56		2	A
Carbon Tetrachloride	56-23-5	0.035	2	117	119		2	D
2,2,4-Trimethylpentane	540-84-1	0.2	2	57	41	43	2	A
1,2-Dichloroethene (total)	540-59-0	0.2	2	61	96		1	A
Benzene	71-43-2	0.2	2	78	77		2	A
1,2-Dichloroethane	107-06-2	0.2	2	62	98		2	A
n-Heptane	142-82-5	0.2	2	43	71		2	A
Trichloroethene	79-01-6	0.035	0.40	95	130	132	2	D
Methyl Methacrylate	80-62-6	0.5	5	69	41	39	2	B

Analyte	CAS No.	6L RL (ppbv)	1L RL (ppbv)	Quantifier Mass	Qualifier Mass	Qualifier Mass	ISTD Group	Analyte Group
1,2-Dichloropropane	78-87-5	0.2	2	63	41		2	A
1,4-Dioxane	123-91-1	5	50	88	58		2	C
Dibromomethane	74-95-3	0.2	2	174	93	172	2	A
Bromodichloromethane	75-27-4	0.2	2	83	85		2	A
cis-1,3-Dichloropropene	10061-01-5	0.2	2	75	110		2	A
Methyl Isobutyl Ketone	108-10-1	0.5	5	43	58		2	B
n-Octane	111-65-9	0.2	2	43	57	114	2	A
Toluene	108-88-3	0.2	2	92	91		3	A
trans-1,3-Dichloropropene	10061-02-6	0.2	2	75	110		2	A
1,1,2-Trichloroethane	79-00-5	0.2	2	83	97	85	3	A
Tetrachloroethene	127-18-4	0.035	0.40	166	168	129	3	D
Methyl Butyl Ketone	591-78-6	0.5	5	43	58		3	B
Dibromochloromethane	124-48-1	0.2	2	129	127		3	A
1,2-Dibromoethane	106-93-4	0.2	2	107	109		3	A
Nonane	111-84-2	0.2	2	57	71	128	3	A
Chlorobenzene	108-90-7	0.2	2	112	77	114	3	A
Ethylbenzene	100-41-4	0.2	2	91	106		3	A
Xylene (m,p)	1330-20-7	0.5	5	106	91		3	A
Xylene (o)	95-47-6	0.2	2	106	91		3	A
Styrene	100-42-5	0.2	2	104	78		3	A
Bromoform	75-25-2	0.2	2	173	175	171	3	A
Cumene	98-82-8	0.2	2	105	120	77	3	A
1,1,2,2-Tetrachloroethane	79-34-5	0.2	2	83	131	85	3	A
Xylene (total)	1330-20-7	0.2	2	106	91		3	A
n-Decane	124-18-5	0.5	5	57	71	142	3	B
n-Propylbenzene	103-65-1	0.2	2	91	120	92	3	A
1,2,3-Trichoropropane	96-18-4	0.5	5	75	110	112	3	B
4-Ethyltoluene	622-96-8	0.2	2	105	120		3	A
1,3,5-Trimethylbenzene	108-67-8	0.2	2	105	120		3	A
2-Chlorotoluene	95-49-8	0.2	2	91	63		3	A
tert-Butylbenzene	98-06-6	0.2	2	119	91	134	3	A
1,2,4-Trimethylbenzene	95-63-6	0.2	2	105	120		3	A
sec-Butylbenzene	135-98-8	0.2	2	105	134	91	3	A
4-Isopropyltoluene	99-87-6	0.2	2	119	134	91	3	A
1,3-Dichlorobenzene	541-73-1	0.2	2	146	111	148	3	A
1,4-Dichlorobenzene	106-46-7	0.2	2	146	111	148	3	A
n-Undecane	1120-21-4	5	50	57	71	156	3	C
Benzyl Chloride	100-44-7	0.2	2	91	126	65	3	A
n-Butylbenzene	104-51-8	0.2	2	91	134	92	3	A
1,2-Dichlorobenzene	95-50-1	0.2	2	146	111	148	3	A
n-Dodecane	112-40-3	5	50	57	71	170	3	C
1,2,4-Trichlorobenzene	120-82-1	0.5	5	180	182		3	B

Analyte	CAS No.	6L RL (ppbv)	1L RL (ppbv)	Quantifier Mass	Qualifier Mass	Qualifier Mass	ISTD Group	Analyte Group
1,3-Hexachlorobutadiene	87-68-3	0.2	2	225	223		3	A
Naphthalene	91-20-3	0.5	5	128			3	B
1,2,3-Trichlorobenzene	87-61-6	0.2	2	180	182	145	3	A
Propylene	115-07-1	5	50	41	42	39	1	C
Vinyl Acetate	108-05-4	5	50	43	86		1	C
Ethyl Acetate	141-78-6	5	50	43	74		1	C
Ethanol	64-17-5	5	50	46	45		1	E
Bromochloromethane	74-97-5	NA	NA	128	49	130	1	NA
1,4-Difluorobenzene	540-36-3	NA	NA	114			2	NA
Chlorobenzene-d5	3114-55-4	NA	NA	117			3	NA

Table 1B: TO-3 Analyte List, Reporting Limit, Internal Standard and Ion Assignments

Analyte	CAS No.	RL (ppbv)	Qualifier Ion	Qualifier Ion	Qualifier Ion	ISTD Group
n-Octane	111-65-9	0.2	43	57	114	2
Toluene	108-88-3	0.2	92	91		3
TVOC as Toluene	NA	11				NA
GRO as Octane	NA	14				NA
Total Hydrocarbons	NA	76 ug/m3				NA
Internal Standards						
Bromochloromethane	74-97-5	NA	128	49	130	1
1,4-Difluorobenzene	540-36-3	NA	114			2
Chlorobenzene-d5	3114-55-4	NA	117			3

Table 2: Tune Standard Criteria

Mass	Ion Abundance Criteria
50	8.0 to 40.0 percent of mass 95
75	30.0 to 66.0 percent of mass 95
95	Base Peak, 100 percent relative abundance
96	5.0 to 9.0 percent of mass 95
173	Less than 2.0 percent of mass 174
174	50.0 to 120.0 percent of mass 95
175	4.0 to 9.0 percent of mass 174
176	93.0 to 101.0 percent of mass 174
177	5.0 to 9.0 percent of mass 176

Table 3: TO15 QC Summary & Recommended Corrective Action (Routine and DoD)

QC Check	Frequency	Acceptance Critera	Recommended Corrective Action
Tune Standard	Prior to calibration and every 24 hours	See Table 2	Correct Problem. Reanalyze. No samples may be analyzed without a valid tune.
ICAL	Prior to sample analysis and when CCV fails	RSD for each analyte ≤ 30% with 2 exceptions up to 40%	Correct problem and repeat calibration
ICV	Once after each ICAL	%R for all analytes within 70-130	Correct Problem. Reanalyze, re-make, re-verify & re-analyze. If that fails, re-make all standards and repeat calibration.
Retention Time Window	Once per ICAL	NA	NA
RRT	With each sample	RRT of each target analyte in each calibration standard within ± 0.06 RRT units.	Correct Problem. Repeat ICAL
CCV	Daily before sample analysis after tune standard	%D ≤ 30	Correct Problem. Reanalyze once. If that fails, see section 10.2.5 for instruction.
Closing CCV	At the end of the analytical sequence, within 24 hours of opening tune acquisition.	%D ≤ 30	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) until a passing CCV is attained, and then reanalyze all associated samples since last acceptable CCV. If necessary, perform a new initial calibration and then reanalyze all associated samples since the last acceptable CCV. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. With client permission, closing CCV criteria of 50% can be utilized.
LCS	Each batch or every 20 samples, whichever is sooner.	**Routine**: %R for all analytes by statistically generated limits. See Table 4. **DoD**: %R for all analytes by QSM 5.1 limits, see Appendix C.	Reanalyze LCS or re-prep and reanalyze LCS and all associated samples if sufficient sample volume is available. If corrective action not successful, initiate nonconformance report and qualify sample results.
LCSD	Per Client Request or when there is insufficient volume for a sample duplicate	RPD ≤ 25	Reanalyze LCSD or re-prep and reanalyze LCSD and all associated samples if sufficient sample volume is available. If corrective action is not successful, initiate nonconformance report and qualify sample results.
Method Blank	Each batch or every 20 samples, whichever is sooner.	No analytes detected above RL	Reanalyze along with associated samples, unless detects for same compounds found in blank are greater than 10X the concentration found in the blank.
Internal Standard	All standards, field and QC samples	+/- 40% of the mean response over the calibration range. See sec. 10.2.2 RT +/- 0.33 min (20 seconds) from last acceptable calibration.	Inspect system for malfunction. Reanalyze samples. Qualify data.
Sample Duplicate	One per batch of 20 samples or fewer	RPD ≤ 25 when one or both results are greater than five times the RL.	Consult with PM. Reanalyze or qualify data.

Table 4: In-house LCS limits**

Analyte	In-House Lower Limits %R	In-House Upper Limits %R	RPD
1,1,1-Trichloroethane	72	127	25%
1,1,2,2-Tetrachloroethane	74	126	25%
1,1,2-Trichloro-1,2,2-trifluoroethane	70	121	25%
1,1,2-Trichloroethane	75	126	25%
1,1-Dichloroethane	66	130	25%
1,1-Dichloroethene	68	120	25%
1,2,3-Trichlorobenzene	*50	*150	25%
1,2,3-Trichloropropane	71	125	25%
1,2,4-Trichlorobenzene	*50	*150	25%
1,2,4-Trimethylbenzene	71	129	25%
1,2-Dichloro-1,1,2,2-tetrafluoroethane	71	141	25%
1,2-Dichlorobenzene	68	129	25%
1,2-Dichloroethane	68	135	25%
1,2-Dichloroethene, Total	73	126	25%
1,2-Dichloropropane	69	128	25%
1,3,5-Trimethylbenzene	72	126	25%
1,3-Dichlorobenzene	69	131	25%
1,4-Dichlorobenzene	67	132	25%
1,4-Dioxane	66	129	25%
2-Butanone (MEK)	72	124	25%
2-Chlorotoluene	74	126	25%
2-Hexanone	57	143	25%
2-Methyl-2-propanol	66	132	25%
2-Methylbutane	56	150	25%
3-Chloro-1-propene	*50	*150	25%
4-Ethyltoluene	75	129	25%
4-Isopropyltoluene	68	130	25%
4-Methyl-2-pentanone (MIBK)	58	144	25%
Acetone	54	154	25%
Acetonitrile	60	154	25%
Acrolein	*50	*150	25%
Acrylonitrile	65	140	25%
Alpha Methyl Styrene	71	132	25%
Benzene	73	119	25%
Benzyl chloride	60	136	25%
Bromoform	53	149	25%
Bromomethane	72	124	25%
Butadiene	58	139	25%

Analyte	In-House Lower Limits %R	In-House Upper Limits %R	RPD
Butane	53	151	25%
Carbon disulfide	71	138	25%
Carbon tetrachloride	71	133	25%
Chlorobenzene	76	119	25%
Chlorodibromomethane	73	125	25%
Chlorodifluoromethane	60	147	25%
Chloroethane	68	130	25%
Chloroform	73	124	25%
Chloromethane	56	141	25%
cis-1,2-Dichloroethene	72	121	25%
cis-1,3-Dichloropropene	74	125	25%
Cyclohexane	76	124	25%
Dibromomethane	68	126	25%
Dichlorobromomethane	75	127	25%
Dichlorodifluoromethane	61	142	25%
Dodecane	*50	*150	25%
Ethanol	*50	*150	25%
Ethyl acetate	70	131	25%
Ethyl ether	71	143	25%
Ethylbenzene	74	122	25%
Ethylene Dibromide	78	122	25%
Hexachlorobutadiene	58	130	25%
Hexane	63	138	25%
Isooctane	68	131	25%
Isopropyl alcohol	53	142	25%
Isopropylbenzene	73	123	25%
Methyl methacrylate	73	129	25%
Methyl tert-butyl ether	70	127	25%
Methylene Chloride	59	137	25%
m-Xylene & p-Xylene	76	121	25%
Naphthalene	*50	*150	25%
n-Butanol	50	156	25%
n-Butylbenzene	65	137	25%
n-Decane	68	134	25%
n-Heptane	60	142	25%
n-Nonane	70	131	25%
n-Octane	62	144	25%
N-Propylbenzene	73	127	25%
o-Xylene	73	123	25%

Analyte	In-House Lower Limits %R	In-House Upper Limits %R	RPD
Pentane	59	152	25%
Propene	*50	*150	25%
sec-Butylbenzene	70	128	25%
Styrene	74	125	25%
tert-Butylbenzene	71	125	25%
Tetrachloroethene	70	125	25%
Tetrahydrofuran	60	149	25%
Toluene	75	122	25%
trans-1,2-Dichloroethene	69	137	25%
trans-1,3-Dichloropropene	74	128	25%
Trichloroethene	73	122	25%
Trichlorofluoromethane	70	129	25%
Undecane	62	136	25%
Vinyl acetate	59	149	25%
Vinyl bromide	75	125	25%
Vinyl chloride	61	135	25%
Xylenes, Total	75	122	25%
1,1,1-Trichloroethane	72	127	25%
1,1,2,2-Tetrachloroethane	74	126	25%

*These are poor performing compounds. Limits for poor performing compounds will be no wider than 50-150%.
**The limits in this table are those in effect as of the published date of this SOP. These limits are based on historical data and are subject to change. Current in-house limits are populated in the LIMS database. Contact a laboratory representative for the most current set of limits. Limit Ref: 2019CCTO15

Appendix A: Terms and Definitions

Acceptance Criteria: Specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: Environmental samples that are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria. An analytical batch is composed of prepared environmental samples (extracts, digestates and concentrates), which are analyzed together as a group.

Calibration: a set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): An analytical standard gas mixture containing all target analytes and internal standard compounds that is used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Cryogen: A refrigerant used to obtain very low temperatures in the cryogenic trap of the analytical system. A typical cryogen is liquid nitrogen (bp -195.8℃) or liquid argon (bp -185.7℃).

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Initial Calibration Verification (ICV): An analytical standard mixture containing all target analytes and internal standard compounds that are prepared from a source independent of the source of the initial calibration standards. The purpose of the ICV is to verify that the initial calibration is in control.

Intermediate Standard: a solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Internal Standards (IS): Non-target analytes that are similar to the target analytes but are not expected to be found in environmental media (generally, isotopically labeled target analytes are used for this purpose). IS are added to every standard, quality control sample, and field sample at a known concentration prior to analysis. IS responses are used as the basis for quantitation of target analytes.

Laboratory Control Sample (LCS) – A QC sample of known composition spiked with analytes of interest. The LCS evaluates method performance and ability to successfully recover target analytes from a clean matrix. LCS recovery is typically expressed as percent recovery and provides a measure of accuracy. A LCSD is a duplicate LCS prepared and analyzed from a separate canister to provide a measure of replicate precision.

Method Blank (MB): A canister of humidified ultra pure zero air that is treated exactly as a sample. The MBLK is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.

Method Detection Limit (MDL): the minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a <u>range</u> where qualitative detection occurs. Quantitative results are not produced in this range.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample.

Stock Gas Mixture: A Commercially purchased concentrated gas mixture containing one or more method analytes

Appendix B: Standard Preparation Tables

The standard formulations contained in this appendix are recommended and are subject to change. If the concentration or volume of any of the stock standard changes, the standard preparation instructions must be adjusted accordingly. See laboratory SOP BR-QA-002 *Standard Preparation* for further guidance on the preparation of standard solutions.

Prepare all standards using the McMillan Company 80SD mass flow controller. Prepare the standard in zero air, demonstrated to be analyte free. Store the standard at ambient temperature. Unless otherwise specified, assign an expiration date of 30 days from date of preparation unless the parent standard expires earlier, in which case, use the earliest expiration date.

Intermediate Calibration Standard

Parent Standard	Vendor	Stock Standard Concentration (ppmv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
Custom Calibration Stock Standard	Spectra Gases Custom Made	1.0	7500	37.5	200

Prepare in 15 L Summa Canister Expiration Period 3months
This standard contains all the target analytes listed in table 1.

Working Calibration Standards

Parent Standard	Calibration Standard	Parent Standard Concentration (ppbv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
Cal Standard 20 ppbv	Cal Standard 0.2 ppbv	20	155	15.46	0.2
Cal Standard 20 ppbv	Cal Standard 0.5 ppbv	20	386	15.46	0.5
Intermediate Calibration Standard	Cal Standard 5 ppbv	200	386	15.46	5
Intermediate Calibration Standard	Cal Standard 10 ppbv	200	773	15.46	10
Intermediate Calibration Standard	Cal Standard 15 ppbv	200	1160	15.46	15
Intermediate Calibration Standard	Cal Standard 20 ppbv	200	1546	15.46	20
Intermediate Calibration Standard	Cal Standard 40 ppbv	200	3092	15.46	40

Prepare in 6 L Summa Canister Expiration Period 3 months
Each calibration standard contains all the analytes listed in table 1 at the above concentrations.

Intermediate ICV/LCS Standard

Parent Standard	Vendor	Stock Standard Concentration (ppmv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
ICV Stock Standard	Spectra Gases Custom Made	1.0	7500	37.5	200

Prepare in 15L Summa Canister Expiration period 3 months
This standard contains all target analytes listed in table 1.

Working ICV/LCS Standard

Parent Standard	Calibration Standard	Stock Standard Concentration (ppbv)	Volume Added (mL)	Final Volume (L)	Final Concentration (ppbv)
Intermediate ICV/LCS Standard	ICV Standard 10 ppbv	200	773	15.46	10

Prepare in 6L Summa Canister Expiration period 3 months

This standard contains all target analytes listed in table 1.

Initial Calibration Levels

Calibration Level	Working Calibration Standard	Volume Analyzed (mL)	Concentration on Column (ppbv)
Calibration Level 1	Cal Standard 0.2 ppbv	40	0.04
Calibration Level 2	Cal Standard 0.2 ppbv	200	0.2
Calibration Level 3	Cal Standard 0.5 ppbv	200	0.5
Calibration Level 4	Cal Standard 5 ppbv	200	5
Calibration Level 5	Cal Standard 10 ppbv	200	10
Calibration Level 6	Cal Standard 15 ppbv	200	15
Calibration Level 7	Cal Standard 20 ppbv	200	20
Calibration Level 8	Cal Standard 40 ppbv	200	40
ICV	Intermediate ICV 10ppb	200	10

Prepare in 6L Summa Canister

Intermediate Ethanol Calibration Standard at 500ppbv/v

1) Fill a 44 ml VOA vial with VOA free water. Remove 197ul of water from the vial.
2) Add 197 ul of >99.5% Ethanol neat material
3) Cap and shake/roll vial for 1 minute
4) Inject 10ul of the prepared water/ethanol mix into a fully evacuated 15 liter summa canister
5) Pump the syringe plunger 5 times to insure complete transfer of material
6) Immediately fill the canister to 22 psig with zero air.

Calibration Level	Working Calibration Standard	Volume added (mL)	Concentration on Column (ppbv)
Calibration Level 1	Cal Standard 0.5 ppbv	124	5
Calibration Level 2	Cal Standard 5.0 ppbv	309	10
Calibration Level 3	Cal Standard 10ppbv	464	15
Calibration Level 4	Cal Standard 15 ppbv	618	20
Calibration Level 5	Cal Standard 20 ppbv	1237	40
Calibration Level 6	Cal Standard 40 ppbv	3092	100

Appendix C: DOD QSM 5.1 LCS Limits

Analytes	CAS #	Lower Limit	Upper Limit	Units
Propene	115-07-1	57	136	%
Dichlorodifluoromethane	75-71-8	59	128	%
Chlorodifluoromethane	75-45-6	59	145	%
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2	63	121	%
Chloromethane	74-87-3	59	132	%
Butane	106-97-8	64	129	%
Vinyl chloride	75-01-4	64	127	%
Butadiene	106-99-0	66	134	%
Bromomethane	74-83-9	63	134	%
Chloroethane	75-00-3	63	127	%
Vinyl bromide	593-60-2	71	126	%
Trichlorofluoromethane	75-69-4	62	126	%
Ethanol	64-17-5	59	125	%
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	66	126	%
1,1-Dichloroethene	75-35-4	61	133	%
Acetone	67-64-1	58	128	%
Isopropyl alcohol	67-63-0	52	125	%
Carbon disulfide	75-15-0	57	134	%
3-Chloro-1-propene	107-05-1	71	131	%
Methylene Chloride	75-09-2	62	115	%
2-Methyl-2-propanol	75-65-0	24	150	%
Methyl tert-butyl ether	1634-04-4	66	126	%
trans-1,2-Dichloroethene	156-60-5	67	124	%
Hexane	110-54-3	63	120	%
1,1-Dichloroethane	75-34-3	68	126	%
Vinyl acetate	108-05-4	56	139	%
Ethyl acetate	141-78-6	65	128	%
2-Butanone (MEK)	78-93-3	67	130	%
cis-1,2-Dichloroethene	156-59-2	70	121	%
Chloroform	67-66-3	68	123	%
Tetrahydrofuran	109-99-9	64	123	%
1,1,1-Trichloroethane	71-55-6	68	125	%
Cyclohexane	110-82-7	70	117	%
Carbon tetrachloride	56-23-5	68	132	%
Isooctane	540-84-1	68	121	%
Benzene	71-43-2	69	119	%
1,2-Dichloroethane	107-06-2	65	128	%
n-Heptane	142-82-5	69	123	%
Trichloroethene	79-01-6	71	123	%
Methyl methacrylate	80-62-6	70	128	%
1,2-Dichloropropane	78-87-5	69	123	%
1,4-Dioxane	123-91-1	71	122	%
Dichlorobromomethane	75-27-4	72	128	%
cis-1,3-Dichloropropene	10061-01-5	70	128	%
4-Methyl-2-pentanone (MIBK)	108-10-1	67	130	%
Toluene	108-88-3	66	119	%
trans-1,3-Dichloropropene	10061-02-6	75	133	%
1,1,2-Trichloroethane	79-00-5	73	119	%
Tetrachloroethene	127-18-4	66	124	%
2-Hexanone	591-78-6	62	128	%
Chlorodibromomethane	124-48-1	70	130	%
Ethylene Dibromide	106-93-4	74	122	%

Analytes	CAS #	Lower Limit	Upper Limit	Units
Chlorobenzene	108-90-7	70	119	%
Ethylbenzene	100-41-4	70	124	%
m-Xylene & p-Xylene	179601-23-1	61	134	%
o-Xylene	95-47-6	67	125	%
Styrene	100-42-5	73	127	%
Bromoform	75-25-2	66	139	%
Isopropylbenzene	98-82-8	68	124	%
1,1,2,2-Tetrachloroethane	79-34-5	65	127	%
N-Propylbenzene	103-65-1	69	123	%
2-Chlorotoluene	95-49-8	74	130	%
tert-Butylbenzene	98-06-6	65	124	%
1,2,4-Trimethylbenzene	95-63-6	66	132	%
sec-Butylbenzene	135-98-8	68	125	%
4-Isopropyltoluene	99-87-6	67	130	%
1,3-Dichlorobenzene	541-73-1	65	130	%
1,4-Dichlorobenzene	106-46-7	60	131	%
Benzyl chloride	100-44-7	50	147	%
n-Butylbenzene	104-51-8	66	130	%
1,2-Dichlorobenzene	95-50-1	63	129	%
1,2,4-Trichlorobenzene	120-82-1	55	142	%
Hexachlorobutadiene	87-68-3	56	138	%
Naphthalene	91-20-3	57	138	%
1,2,3-Trichloropropane	96-18-4	76	124	%
Acetonitrile	75-05-8	63	132	%
Acrolein	107-02-8	62	126	%
n-Decane	124-18-5	70	118	%
n-Nonane	111-84-2	63	128	%
n-Octane	111-65-9	69	121	%
Dodecane	112-40-3	62	147	%
Undecane	1120-21-4	69	123	%
Pentane	109-66-0	63	131	%
Acrylonitrile	107-13-1	71	137	%
Alpha Methyl Styrene	98-83-9	67	128	%
n-Butanol	71-36-3	62	133	%

ATTACHMENT 5

New York State Department of Health Indoor Air Questionnaire

NEW YORK STATE DEPARTMENT OF HEALTH
INDOOR AIR QUALITY QUESTIONNAIRE AND BUILDING INVENTORY
CENTER FOR ENVIRONMENTAL HEALTH

This form must be completed for each residence involved in indoor air testing.

Preparer's Name ____________________________________ Date/Time Prepared ______________

Preparer's Affiliation ________________________________ Phone No.______________________

Purpose of Investigation____

1. OCCUPANT:

Interviewed: Y / N

Last Name: _________________________ First Name: _________________________

Address: ____

County: _________________

Home Phone: ____________________ Office Phone: ____________________

Number of Occupants/persons at this location _______ Age of Occupants ______________________

2. OWNER OR LANDLORD: (Check if same as occupant ___)

Interviewed: Y / N

Last Name: _________________________First Name: ___________________________

Address: ____

County: _________________

Home Phone: ____________________ Office Phone: ____________________

3. BUILDING CHARACTERISTICS

Type of Building: (Circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: _________________

If the property is residential, type? (Circle appropriate response)

Ranch
Raised Ranch
Cape Cod
Duplex
Modular
2-Family
Split Level
Contemporary
Apartment House
Log Home
3-Family
Colonial
Mobile Home
Townhouses/Condos
Other:_______________

If multiple units, how many? ________

If the property is commercial, type?

Business Type(s) ______________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? ______

Other characteristics:

Number of floors______ Building age______

Is the building insulated? Y / N How air tight? Tight / Average / Not Tight

4. AIRFLOW

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow between floors

Airflow near source

Outdoor air infiltration

Infiltration into air ducts

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (Circle all that apply)

a. Above grade construction:	wood frame	concrete	stone	brick
b. Basement type:	full	crawlspace	slab	other ________
c. Basement floor:	concrete	dirt	stone	other ________
d. Basement floor:	uncovered	covered	covered with ________________	
e. Concrete floor:	unsealed	sealed	sealed with _________________	
f. Foundation walls:	poured	block	stone	other ________
g. Foundation walls:	unsealed	sealed	sealed with _________________	
h. The basement is:	wet	damp	dry	moldy
i. The basement is:	finished	unfinished	partially finished	
j. Sump present?	Y / N			
k. Water in sump?	Y / N / not applicable			

Basement/Lowest level depth below grade: ________(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

6. HEATING, VENTING and AIR CONDITIONING (Circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation
Space Heaters
Electric baseboard
Heat pump
Stream radiation
Wood stove
Hot water baseboard
Radiant floor
Outdoor wood boiler
Other ___________

The primary type of fuel used is:

Natural Gas
Electric
Wood
Fuel Oil
Propane
Coal
Kerosene
Solar

Domestic hot water tank fueled by: _____________________________

Boiler/furnace located in:	Basement	Outdoors	Main Floor	Other___________
Air conditioning:	Central Air	Window units	Open Windows	None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

____

7. OCCUPANCY

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

Level	**General Use of Each Floor (e.g., familyroom, bedroom, laundry, workshop, storage)**
Basement	____
1st Floor	____
2nd Floor	____
3rd Floor	____
4th Floor	____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY

a. Is there an attached garage?		Y / N
b. Does the garage have a separate heating unit?		Y / N / NA
c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, atv, car)		Y / N / NA Please specify__________________
d. Has the building ever had a fire?		Y / N When?_________________
e. Is a kerosene or unvented gas space heater present?		Y / N Where? ________________
f. Is there a workshop or hobby/craft area?	Y / N	Where & Type? ________________
g. Is there smoking in the building?	Y / N	How frequently? _______________
h. Have cleaning products been used recently?	Y / N	When & Type? ________________
i. Have cosmetic products been used recently?	Y / N	When & Type? ________________

j. Has painting/staining been done in the last 6 months? Y / N Where & When? _______________

k. Is there new carpet, drapes or other textiles? Y / N Where & When? _______________

l. Have air fresheners been used recently? Y / N When & Type? ________________

m. Is there a kitchen exhaust fan? Y / N If yes, where vented?____________

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?____________

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?_________________

Are there odors in the building? Y / N
If yes, please describe: ____

Do any of the building occupants use solvents at work? Y / N
(e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (Circle appropriate response)

Yes, use dry-cleaning regularly (weekly)
Yes, use dry-cleaning infrequently (monthly or less)
Yes, work at a dry-cleaning service
No
Unknown

Is there a radon mitigation system for the building/structure? Y / N Date of Installation: ____________
Is the system active or passive? Active/Passive

9. WATER AND SEWAGE

Water Supply: Public Water Drilled Well Driven Well Dug Well Other: _______

Sewage Disposal: Public Sewer Septic Tank Leach Field Dry Well Other: _______

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: _____________________________________

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s) and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: ______________________________________

List specific products found in the residence that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo ** Y / N

* Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D)**
** Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

APPENDIX C

Community Air Monitoring Plan

New York State Department of Health (NYSDOH)
Generic Community Air Monitoring Plan (CAMP)

Overview

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

The generic CAMP presented below will be sufficient to cover many, if not most sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical-specific monitoring with appropriately sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required 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.

VOC Monitoring, Response Levels, and Actions

VOCs must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. 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 must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can 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.
3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.
4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must 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.

1. 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 must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can 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.
3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

APPENDIX D

Site Specific Health and Safety Plan
(Provided on CD in Bound Copy)

Site-Specific Health and Safety Plan

5000 1st Avenue
Brooklyn, New York

October 1, 2021

Prepared for:

Steiner Sequel, LLC
15 Washington Avenue
Brooklyn, New York 11205

Prepared by:

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

3454.0001Y102/CV

Environmental Consulting
& Management
+1.800.322.ROUX
rouxinc.com

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Appendices

Site-Specific Emergency Information

Emergency Phone Numbers

Most emergency services can be obtained by calling **911**. Where 911 service is not available, use the telephone numbers provided in the below table. The following is a master emergency phone list for use by the project management personnel. A more condensed version of the emergency numbers listed below will be posted throughout project work areas. Emergencies encountered on the site will be responded to by a combination of offsite emergency services and onsite personnel.

<table>
<tr><th colspan="4">Emergency Contact Information</th></tr>
<tr><th colspan="4">Site Personnel</th></tr>
<tr><th>Title</th><th colspan="2">Contact</th><th>Telephone</th></tr>
<tr><td>Office Manager (OM)</td><td colspan="2">Michael Ritorto</td><td>631-630-2370</td></tr>
<tr><td>Project Principal (PP)</td><td colspan="2">Frank Cherena</td><td>631-445-0357</td></tr>
<tr><td>Project Manager (PM)</td><td colspan="2">Lauren Dolginko</td><td>631-630-2415</td></tr>
<tr><td>Site Supervisor (SS)</td><td colspan="2">Lauren Dolginko</td><td>631-630-2415</td></tr>
<tr><td>Site Health and Site Safety Officer (SHSO)</td><td colspan="2">Lauren Dolginko</td><td>631-630-2415</td></tr>
<tr><td>Office Health and Safety Manager (OHSM)</td><td colspan="2">Kristina DeLuca</td><td>631-630-2406</td></tr>
<tr><td>Corporate Health and Safety Manager (CHSM)</td><td colspan="2">Brian Hobbs</td><td>631-630-2419</td></tr>
<tr><td>AllOne Health</td><td colspan="2">Occupational Health Care Management Provider</td><td>800-350-4511</td></tr>
<tr><td>Client Emergency Contact</td><td colspan="2">Benjamin Tressler</td><td>718-858-1600</td></tr>
<tr><th colspan="4">Outside Assistance</th></tr>
<tr><th>Agency</th><th>Contact</th><th>Telephone</th><th>Address/Location</th></tr>
<tr><td>Ambulance/emergency medical services (EMS)</td><td>FDNY EMS Station 40</td><td>718-437-3539</td><td>5011 7th Avenue, Brooklyn, New York 11220</td></tr>
<tr><td>Police</td><td>NYPD – 68th Precinct</td><td>718-439-4211</td><td>333 65th Street, Brooklyn, New York 11220</td></tr>
<tr><td>Fire</td><td>FDNY Engine 201/Ladder 114/Battalion 40</td><td>911</td><td>5113 4th Avenue, Brooklyn, New York 11220</td></tr>
<tr><td>Site Address</td><td colspan="3">5102 1st Avenue, Brooklyn, New York 11232</td></tr>
</table>

Directions to NYU Langone Hospital Brooklyn:

- Head southwest on 50th Street toward 1st Avenue
- Turn right onto 2nd Avenue
- Arrive at **150 55th Street, Brooklyn, New York 11220**

Directions to CityMD Sunset Park Urgent Care - Brooklyn:

- Head southwest on 50th Street toward 1st Avenue
- Turn right onto 5th Avenue
- Arrive at **5024 5th Avenue, Brooklyn, New York 11220**

1. Introduction

This Site-specific Health and Safety Plan (HASP) has been prepared by Roux Environmental Engineering and Geology, D.P.C. (Roux) for use during implementation of the Remedial Investigation Work Plan/Interim Remedial Measure Work Plan (RIWP/IRMWP) at the Former Bush Terminal site, located at 5102 1st Avenue, Brooklyn, NY 11232 (Site; **Figure 1**). These activities fall within the scope of operations covered by the Occupational Safety and Health Administration (OSHA) standards promulgated at 29 CFR 1910.120 and 29 CFR 1926.65, both commonly referred to as the Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard. In accordance with the HAZWOPER Standard, this Site-specific HASP was prepared to address the safety and health hazards associated with the drilling, sampling and remedial activities being performed at the Site by Roux and to provide requirements and procedures for the protection of Roux employees, subcontractor personnel, government oversight personnel, Site personnel, and the general public. It also addresses client- and Site-specific requirements for health and safety. Additionally, subcontractors may be required to submit their own HASP as it relates to their specific work activities and will be kept onsite during such work.

Implementation of this HASP is the joint responsibility of the Project Manager (PM), the Site Health and Safety Officer (SHSO), and all field staff, with assistance from the Project Principal (PP), Office Health and Safety Manager (OHSM), and Corporate Health and Safety Manager (CHSM). The PM, Site Supervisor (SS, and SHSO for this project is Lauren Dolginko.

This HASP will be introduced to, reviewed, and signed off on by all Roux personnel through a formal training session prior to commencing work. A copy of the HASP will be kept at the Site at all times. The Roux SHSO or PM will be responsible for posting any changes, amendments, memos, etc. to the HASP. Any revisions to this HASP will be signed by appropriate personnel, which can include Roux's PP, CHSM, and SS. Any changes will be announced to all workers at the next safety meeting.

1.1 Roles and Responsibilities

Overall Roles and Responsibilities (R&Rs) of Roux personnel are provided in Roux's Policies and Procedures Manual. Only those R&Rs specific to HASP requirements are listed below.

Project Manager (PM)

The PM has responsibility and authority to direct all work operations. The PM coordinates safety and health functions with the SHSO, has the authority to oversee and monitor the performance of the SHSO, and bears ultimate responsibility for the proper implementation of this HASP. The specific duties of the PM are:

- Preparing and coordinating the Site work plan;
- Providing SS with work assignments and overseeing their performance; Coordinating safety and health efforts with the SHSO;
- Ensuring effective emergency response through coordination with the Emergency Response Coordinator (ERC); and
- Serving as primary Site liaison with public agencies and officials and Site contractors.

Site Health and Safety Officer (SHSO)

The SHSO has the full responsibility and authority to develop and implement this HASP and to verify compliance. The SHSO reports to the Project Manager. The SHSO is onsite or readily accessible to the Site during all work operations and has the authority to halt Site work if unsafe conditions are detected. The specific responsibilities of the SHSO include:

- Managing the safety and health functions on this Site;
- Serving as the Site's point of contact for safety and health matters;
- Ensuring Site monitoring, worker training, and effective selection and use of personal protective equipment (PPE);
- Assessing Site conditions for unsafe acts and conditions and providing corrective action;
- Assisting with the preparation and review of this HASP;
- Maintaining effective health and safety records as described in this HASP; and
- Coordinating with the SS and others as necessary for health and safety efforts.

Site Supervisor (SS)

The SS is responsible for field operations and reports to the PM. The Site Supervisor ensures the implementation of the HASP requirements and procedures in the field. The specific responsibilities of the SS include:

- Executing the work plan and schedule as detailed by the PM;
- Coordination with the SHSO on health and safety; and
- Ensuring Site work compliance with the requirements of this HASP.

Employees

All Roux employees are responsible for reading and following all provisions of the Corporate Health and Safety Manual, including this HASP. Employees report to the SS at the project Site. Each employee is also responsible for the following:

- Wearing all appropriate PPE as outlined within this HASP;
- Attending all safety meetings;
- Inspecting tools and equipment prior to use, and taking any defective tools or equipment out of service;
- Appropriately documenting field events as they occur within a logbook or equivalent;
- Properly operating machinery and/or equipment only if trained to do so;
- Stopping work operations if unsafe conditions exist;
- Identifying and mitigating hazards when observed;
- Reporting all incidents and near losses to the Roux SHSO and SS immediately; and
- Knowing where emergency equipment is located (e.g. first aid kit, fire extinguisher).

Subcontractors and Visitors

Subcontractors and visitors are responsible for complying with the same health and safety requirements. It is the responsibility of all to make sure subcontractors and visitors comply with and uphold the HASP. Subcontractors and visitors have the following additional responsibilities:

- Designating a qualified safety representative for the project that can make the necessary changes in work practices, as necessary;
- Attending all safety meetings while participating in Roux Site work activities;
- Reporting all incidents and near losses to Roux SHSO and SS immediately;
- Conducting initial and periodic equipment inspections in accordance with manufacturer and regulatory guidelines; and
- Providing copies of all Safety Data Sheets (SDSs) to Roux SHSO for materials brought to the Site.

2. Background

Relevant background information is provided below, including a general description of the Site; a brief review of the Site's history with respect to hazardous material use, handling, and/or storage; and a review of known and potential releases of hazardous substances at the Site.

2.1 Site Description

The Site is identified as Former Bush Terminal and is located at 5102 1st Avenue, Brooklyn, New York (**Figure 1**) on the Kings County Tax Map Tax Block 725, p/o Lots 1 and 100. The portion of the Site on Lot 1 has two six-story buildings identified as buildings 57 and 58 and one seven-story building identified as unit G. The north portion of Lot 1 formerly contained buildings 39, 40, and 45, all of which were demolished in 2015. The remainder of the portion of the Site on Lot 1 is vacant or asphalt parking lot. The portion of the Site on Lot 100 consists of an asphalt parking lot and rail lines. The Site is bounded by the following properties, as summarized in the table below:

Adjacent Property Direction	Property Use
North	A healthcare product and equipment distribution center, lighting fixture showroom, and the Bush Terminal Piers Park parking lot.
South	Brooklyn Sanitation Department.
East	A railyard directly adjacent to the Site, 1st Avenue, and industrial use properties including manufacturing and product distribution, a garbage collection company, a storage facility, and a contractor storage yard across 1st Avenue.
West	Bush Terminal Piers Park.

2.2 Site History

Based on Historic Sanborn fire insurance maps (Sanborn maps), in the late 1880s, the Site was mostly vacant while the northern portion of the Site was developed with a residential dwelling and a shed. By 1906, the Site was occupied by warehouse buildings: one seven-story structure (present day unit G designated as warehouse #51-56), two six story structures (warehouse #45-50 and #39-44) located north of unit G, and a 100,000-gallon water tank. Additionally, a rail yard made up the majority of the east side of the Site with rail lines branching off and running in an east-west direction from the rail yard to the shipping piers located outside of the Site, along the western border extending out into the Bay Ridge Channel. By 1922, present day buildings 57 and 58 had been constructed in the southern portion of the Site, and a one-story irregularly shaped structure was constructed between building 57 and unit G. Additional rail lines extending out to the piers toward the west are present on the 1922 Sanborn map. The 1926 Sanborn map shows a building extension south of unit G is the location of a "refrigerating building". The 1951 Sanborn map shows building 58 occupied by a tin manufacturer, building 57 occupied by a packaging company and a coffee roaster, and unit G and the adjacent two six-story structures (#45-50 and #39-44) operated as public warehouses.

The 1965 Sanborn map depicted that two six-story structures adjacent to unit G had been demolished and that a portion of building 45 had been constructed with a two-story garage, and buildings 40 and 30 were constructed. The 1965 Sanborn map also depicted that building 58 was occupied at the time by a paper warehouse and building 57 and unit G was occupied by Van Brunt Stores, Inc. The 1978 Sanborn showed the remainder of building 45 as constructed into its most recent configuration prior to demolition in 2015. The designated year of construction shown on the Sanborn is 1970. Buildings 39, 40, and 45 were demolished in 2015.

2.3 Known and Potential Releases of Hazardous Substances at the Site

TRC Engineers, Inc. (TRC) performed a soil investigation in March 2020, which is summarized in a Phase II Environmental Site Assessment (ESA). Based upon the investigation, the primary contaminants of concern for the Site include semivolatile organic compounds (SVOCs), including polycyclic aromatic hydrocarbons (PAHs) and naphthalene, metals, and polychlorinated biphenyls (PCBs) in soil, volatile organic compounds (VOCs), SVOCs, metals, PCBs, and pesticides in groundwater, and chlorinated volatile organic compounds (CVOCs) and benzene, toluene, ethylbenzene, and xylene (BTEX) compounds in soil vapor.

There are currently no open spills for the Site, however the Site is listed on the New York State Department of Environmental Conservation (NYSDEC) spills database for the following closed spills:

- *Spill #9508159:* the spill was reported on October 3, 1995 and is related to a truck valve malfunction. The spill was contained, and the spill case was closed on October 3, 1995.
- *Spill #9802957:* the spill was reported on June 2, 1998 and is related to a Site investigation that discovered five buried drums containing pesticides. All five drums were removed and 120 tons of soil were excavated and disposed offsite. The spill case was closed on June 5, 1998.
- *Spill #1306670:* the spill was reported on September 25, 2013 during the implementation of a Remedial Investigation (2013 RI) by GCE and is related to an approximately 20 ft by 10 ft area of soil with visible staining associated with one 275-gallon oil aboveground storage tank (AST). The spill was due to poor housekeeping. No additional information regarding remedial actions was provided in the reports, however, the spill case was noted as closed on September 30, 2013.
- *Spill #1306669:* the spill was reported on September 25, 2013 during the implementation of the 2013 RI by GCE and is related to surface staining in the proximity of a different 275-gallon AST from the one associated with Spill #1306670, located to the south of building 45. The cause of the spill is related to poor housekeeping from the contractors. The area of the spill was excavated and approximately 25 tons of soil were removed. Post-excavation samples all yielded non-detect results. The spill case was closed on January 26, 2016.
- *Spill #0102496:* the spill was reported on June 5, 2001 and is related to observed petroleum-impacted soil during test pit excavation outside of the northeastern loading dock of building 39/40. The spill is recorded as an unknown amount of solvents spilled onto the soil. No additional information regarding remedial actions was provided in the reports, however, the spill case was closed on September 13, 2005.

3. Scope of Work

The RIWP/IRMWP Scope of Work (SOW) will focus on the assessment of soil, groundwater, and soil vapor conditions at the Site.

The existing unit G building will be demolished during the IRM. Roux personnel will not be onsite for third-party oversight, air monitoring, or health and safety monitoring during the IRM demolition.

Dependent on Site logistics and investigation schedule, soil samples may be collected via soil boring completed using a Geoprobe direct push drill rig or a test pit by an excavator. To collect additional data to delineate contamination at the Site, soil samples will be collected from the 10 soil borings or test pits. At soil boring locations, pre-clearance will be completed to five ft bls using non-intrusive methods, such as vacuum clearance and hand tools to verify the absence of utilities and/or other subsurface features (i.e., obstructions and/or refusal). Pre-clearance will not be completed if samples are collected via test pit. The soil borings will be advanced to depths ranging from 4 to 20 ft bls.

During advancement of borings, the soil will be inspected for evidence of contamination (visual and olfactory) and field screened continuously for organic vapors using a PID with a 10.6 eV lamp. Soil lithology will be recorded according to the Unified Soils Classification System (USCS). Additional soil samples may be collected from each borehole if further evidence of potential contamination is encountered. If odor/visual evidence of contamination or elevated PID measurements are noted, the additional sample may be collected from the interval that exhibits the greatest evidence of impacts.

Four permanent monitoring wells will be installed for groundwater sample collection and up to three of the existing Site monitoring wells installed adjacent to the Bush Terminal Piers Park Landfill will be purged and sampled. In addition, two sub-slab vapor sample points and one soil vapor point consisting of six-inch long, stainless steel sample screen attached to Teflon-lined polyethylene sample tubing will be installed for soil vapor sample collection.

Additional quality assurance/quality control (QA/QC) samples will be collected in accordance with the Quality Assurance Project Plan/Field Sampling Plan (QAPP/FSP).

If there are any changes to this SOW, a revision of the HASP will be required to address any new hazards.

4. Site Control

This Site control program is designed to reduce the spread of hazardous substances from contaminated areas to clean areas, to identify and isolate contaminated areas of the Site, to facilitate emergency evacuation and medical care, to prevent unauthorized entry to the Site, and to deter vandalism and theft.

4.1 Site Map

A map of this Site, showing Site boundaries and emergency muster areas, is provided in **Figure 2**.

4.2 Site Access

Access to the work areas at the Site will be restricted to reduce the potential for exposure to its health and safety hazards. Once demolition begins, New York City Department of Buildings (NYCDOB) construction fencing will be erected and used as a means of entry/exit. When the Site is not operating, access to the Site will be controlled by onsite security.

4.3 Buddy System

While working in the Exclusion Zone (EZ), Site workers use the buddy system. The buddy system means that personnel work in pairs and stay in close visual contact to be able to observe one another and summon rapid assistance in case of an emergency. The responsibilities of workers using the buddy system include:

- Remaining in close visual contact with partner;
- Providing partner with assistance as needed or requested;
- Observing partner for signs of heat stress or other difficulties;
- Periodically checking the integrity of partner's PPE; and
- Notifying the Site manager or other Site personnel if emergency assistance is needed.

4.4 Site Communications

The following communication equipment is used to support onsite communication: cell phones and visual hand signals.

As applicable, hand signals will be used according to the following:

Hand Signals

SIGNAL	MEANING
Hand gripping throat	Out of air, cannot breathe
Grip partner's wrist	Leave area immediately
Hands on top of head	Need assistance
Thumbs up	I am all right, okay
Thumbs down	No, negative

A current list of emergency contact numbers is included in the Site-Specific Emergency Information at the beginning of this HASP.

4.5 Site Work Zones

This Site is divided into three major zones, described below. These zones are characterized by the likely presence or absence of biological, chemical, or physical hazards and the activities performed within them. Zone boundaries are clearly marked at all times and the flow of personnel among the zones is controlled. The Site is monitored for changing conditions that may warrant adjustment of zone boundaries. Zone boundaries are adjusted as necessary to protect personnel and clean areas. Whenever boundaries are adjusted, zone markings are also changed, and workers are immediately notified of the change.

Exclusion Zone

The area where contamination exists is the EZ. All areas where excavation and handling of contaminated materials take place are considered part of the EZ. This zone will be clearly delineated by chain link fencing, caution tape, cones or other effective barriers, as necessary. Safety tape may be used as a secondary delineation within the EZ. The zone delineation markings may be opened in areas for varying lengths of time to accommodate equipment operation or specific construction activities. The SHSO may establish more than one EZ where different levels of protection may be employed or where different hazards exist. Personnel are not allowed in the EZ without:

- A buddy (co-worker);
- Required minimum level PPE;
- Medical authorization;
- Training certification; and
- Requirement to be in the zone.

Contamination Reduction Zone

A Contamination Reduction Zone (CRZ) is established between the exclusion zone and the Support Zone (SZ). The CRZ contains the Contamination Reduction Corridor (CRC) and provides an area for decontamination of personnel and equipment. The CRZ will be used for general Site entry and egress in addition to access for heavy equipment and emergency support services. Personnel are not allowed in the CRZ without:

- A buddy (co-worker);
- Appropriate PPE;
- Medical authorization;
- Training certification; and
- Requirement to be in the zone.

Support Zone

The SZ is an uncontaminated area that will be the field support area for the Site operations. The SZ will contain the field equipment and 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.

5. Job Hazard Evaluation

Roux's work at the Site is expected to entail a variety of physical, chemical, and biological hazards, all of which must be sufficiently managed to allow the work to be performed safely. Some of the hazards are Site-specific (i.e., they are associated with the nature, physical characteristics, and/or routine operation of the Site itself), while others are activity-specific (i.e., they are associated with [or arise from] the particular activity being performed). The various hazards can be grouped into the following categories:

- **Caught/Crushed** – the potential to become caught in, under, between, or by an object or parts of an object, such as equipment with parts that open and close or move up and down ("pinch points") or equipment that rotates, and the accompanying potential to have body parts cut, mangled, or crushed thereby.
- **Contact** – the potential to be struck by or against moving or stationary objects that can cause physical injury, such as heavy machinery, overhead piping, moving vehicles, falling objects, and equipment (including tools and hand-held equipment) or infrastructure with the ability to cut or impale.
- **Energy Sources** – the potential for bodily harm associated with energy sources, most notably electricity, but also including latent energy sources such as compressed air and equipment under tension (which when released could cause injurious contact or a fall).
- **Ergonomics** – the potential for musculoskeletal injury associated with lifting/carrying, pushing/pulling, bending, reaching, and other physical activity attributable to poor body position/mechanics, repetitive motion, and/or vibration.
- **Exposure** – the potential for injury/illness due to physical, chemical, or biological exposures in the work environment, including but not limited to temperature extremes, solar radiation, and noise (physical), chemical splashes and hazardous atmospheres (chemical), and animal/insect bites and poisonous plants (biological).
- **Falls** – the potential to slip or trip and thus fall or drop a load, resulting in bodily injury to oneself or others.

The foregoing is intended to provide Roux employees with a general awareness of the hazards involved with Site work. A more detailed review of the potential hazards associated with each specific activity planned for the Site (or on-going activity, as the case may be) is provided in the activity-specific Job Safety Analysis (JSA) forms in **Appendix A**. As can be seen in the JSA forms, the hazards are identified by category per the above, and specific measures designed to mitigate/manage those hazards are also identified. In preparing the JSA forms, all categories of hazards were considered, and all anticipated potential hazards were identified to the extent possible based on the experience of the personnel preparing and reviewing the JSA forms. However, there is always the possibility for an unanticipated hazard to arise, potentially as conditions change over the course of the workday. Roux personnel must maintain a continual awareness of potential hazards in the work zone, regardless of whether the hazard is identified in the JSA form. Particular attention should be paid to hazards associated with exposure to hazardous substances (see **Table 1** for a listing of the hazardous substances most likely to be encountered in environmental media at the Site) and to Site personnel being located "in the line of fire" with respect to moving equipment, pinch points, and latent energy (e.g., being located or having body parts located within the swing radius of an excavator, between two sections of pipe being connected, below a piece of suspended equipment, or adjacent to a compressed air line).

5.1 Hazard Communication and Overall Site Information Program

The information in the JSAs and SDSs is made available to all employees and subcontractors who could be affected by it prior to the time they begin their work activities. Modifications to JSAs are communicated during routine pre-work briefings.

The information in the JSAs and SDSs is made available to all employees and subcontractors who could be affected by an exposure to the hazards covered in them prior to the time they begin their work activities. Modifications to JSAs are communicated during routine pre-work briefings, and periodically updated as needed in the HASP. SDSs will be maintained by the SHSO/SS for new chemicals brought onsite as needed. Copies of relevant SDSs can be found in **Appendix B**.

5.2 Noise

Noise is associated with the operation of heavy equipment, power tools, pumps, and generators. Noise is also a potential hazard when working near operating equipment such as excavators, drill rigs or pole drivers. High noise (i.e., < 85 dBA) operations may be evaluated by the SHSO utilizing a type 2 handheld sound level meter (SLM) operating on the "A"-weighted scale with slow response because this scale most closely resembles human response to noise and complies with OSHA 29 CFR 1910.95. Hearing protection is required in areas with noise exposure greater than 85 dBA. Double hearing protection (ear plugs and earmuffs) are required in areas where the noise exposure is more than 95 dBA. Noise exposure will be controlled by hearing protection as described above or by maintaining set-backs from high-noise equipment, as warranted. Personnel handling heavy equipment and using power tools that produce noise levels exceeding those described levels above are required by OSHA 29 CFR 1910.95 to wear the appropriate Noise Reduction Rating (NRR) level of hearing protection. Appropriate hearing protection will be evaluated by the SHSO as necessary in consultation with the OHSM and CHSM.

5.3 Biological Hazards

Biological hazards that may potentially be present at a Site, include poisonous plants, insects (ticks, spiders, bees), animals (snakes, dogs), etc. Information on biological hazards can be found within Roux's Biological Hazard Awareness Management Program located within Roux's Corporate Health and Safety Manual. There is also potential for transmission and/or exposure to SARS-CoV-2, the virus that causes COVID-19. Prior to beginning work, onsite protocols shall be established by the project team, including subcontractors, in accordance with federal, state, county, city, and/or other guidance, as applicable and consistent with **Appendix C**. Government guidance/orders generally consist of implementation of the following protocols/procedures (or some variation thereof):

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

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

6. Emergency Response Plan

This emergency response plan details actions to be taken in the event of Site emergencies. The PM and SHSO are responsible for the implementation of emergency response procedures onsite. The SHSO/PM provides specific direction for emergency action based upon information available regarding the incident and response capabilities and initiates emergency procedures and notification of appropriate authorities. In the event of an emergency, Site personnel are evacuated and do not participate in emergency response activities. Response is facilitated through external emergency services. Any emergency response actions taken at the Site will be followed by an incident investigation and required reporting as detailed in the Incident Investigation and Reporting Management Program **(Appendix D).**

6.1 Emergency Response

The SHSO, after investigating the incident and relevant information, shall determine the level of response required for containment, rescue, and medical care. Limited onsite emergency response activities could occur therefore the SHSO is responsible for notifying external emergency response agencies. The SHSO provides relevant information to the responding organizations, including but not limited to the hazards associated with the emergency incident, potential containment problems, and missing Site personnel.

6.2 Emergency Alerting and Evacuation

If evacuation notice is given, Site workers leave the worksite, if possible, by way of the nearest exit. Appropriate assembly areas have been identified and are shown on the Site Plan with Emergency Muster Area (**Figure 2**). The routes and assembly area will be determined by conditions at the time of the evacuation based on wind direction, the location of the hazard source, and other factors as determined by SHSO/PM.

Personnel exiting the Site gather at a designated assembly point. To determine that everyone has successfully exited the Site, personnel will be accounted for at the assembly point. If any worker cannot be accounted for, notification is given to the SHSO, PM, and any arriving response authorities so that appropriate action can be initiated. Subcontractors on this Site have coordinated their emergency response plans to ensure that these plans are compatible and potential emergencies are recognized, alarm systems are clearly understood, and evacuation routes are accessible to all personnel relying upon them.

6.3 Emergency Medical Treatment and First Aid

In the event of a work-related injury or illness, employees are required to follow the procedures outlined below. All work-place injury and illness situations require Roux's Project and Corporate Management Team to be notified when an injury/illness incident occurs, and communication with the contracted Occupational Health Care Management Provider, AllOne Health (AOH), is initiated. The Injury/Illness Notification Flowchart is provided below and within Roux's Incident Investigation and Reporting program included within Roux's Corporate Health and Safety Manual.

If onsite personnel require any medical treatment, the following steps will be taken:

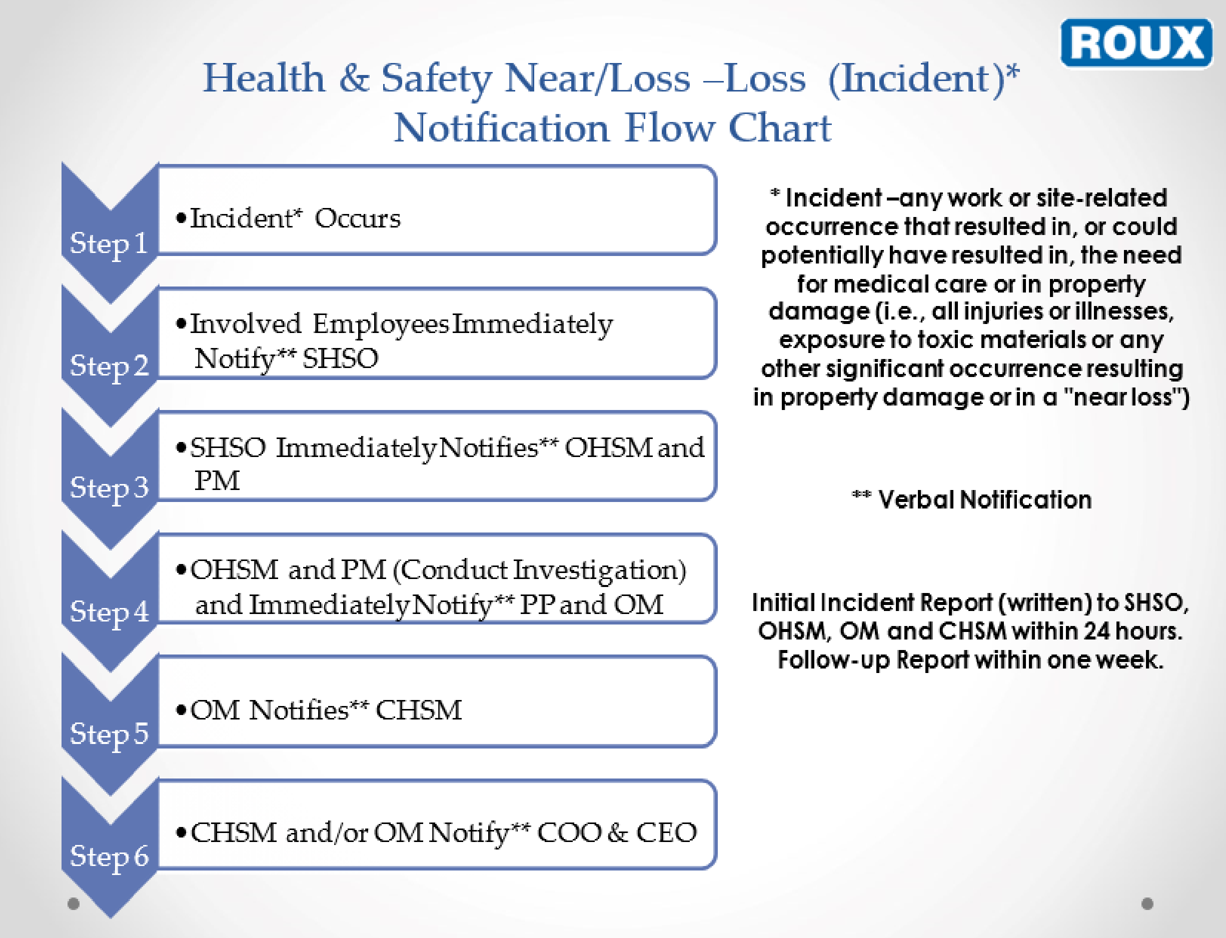
a. Notify Roux's Project and Corporate Management Team for any work-related injury and/or illness occurrence, and communicate with the contracted Occupational Health Care Management Provider, AOH, immediately following the notifications provided above.

b. Based on discussions with the Project Team, Corporate Management, and the AOH evaluation, if medical attention beyond onsite First Aid is warranted, transport the injured/ill person (IP) to the Urgent Care Center, or notify the Fire Department or Ambulance Emergency service and request an ambulance or transport the victim to the hospital, and continue communications with Corporate Management Team. An Urgent Care/Hospital Route map with directions to CityMD Sunset Park Urgent Care – Brooklyn and NYU Langone Hospital Brooklyn is included as **Figure 3**.

c. Decontaminate to the extent possible prior to administration of first aid or movement to medical or emergency facilities.

d. First aid medical support will be provided by onsite personnel trained and certified in First Aid, Cardiopulmonary Resuscitation (CPR), Automatic External Defibrillation (AED), and Blood-Borne Pathogens (BBP) Awareness, until relieved by emergency medical services (EMS).

e. The SHSO and PM will perform a Loss Investigation (LI) and the Project Team will complete the final Loss Report. If a Roux employee is involved in a vehicular incident, the employee must also complete the Acord Automobile Loss Notice.



ROUX

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

Step 1
- Incident* Occurs

Step 2
- Involved Employees Immediately Notify** SHSO

Step 3
- SHSO Immediately Notifies** OHSM and PM

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

Step 5
- OM Notifies** CHSM

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

* Incident –any work or site-related occurrence that resulted in, or could potentially have resulted in, the need for medical care or in property damage (i.e., all injuries or illnesses, exposure to toxic materials or any other significant occurrence resulting in property damage or in a "near loss")

** Verbal Notification

Initial Incident Report (written) to SHSO, OHSM, OM and CHSM within 24 hours. Follow-up Report within one week.

6.4 Adverse Weather Conditions

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

- Potential for heat stress and heat-related injuries;

- Potential for cold stress and cold-related injuries;
- Treacherous weather-related conditions;
- Limited visibility; and
- Electrical storm potential.

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

6.5 Electrical Storm Guidelines

In the event that lightning and/or thunder are observed while working onsite, all onsite activities shall stop and personnel shall seek proper shelter (e.g., substantial building, enclosed vehicle, etc.). Work shall not resume until the threat of lighting has subsided and no lightning or thunder has been observed for 30 minutes. If the possibility of lightning is forecasted for the day, advise the onsite personnel on the risks and proper procedure at the pre-work safety briefing. Continuously monitor for changing weather conditions and allow enough time to properly stop work if lightning is forecasted.

7. Safety Procedures

This section of the HASP presents the specific safety procedures to be implemented during Roux's activities at the Site in order to protect the health and safety of various onsite personnel. Minimum OSHA-mandated procedures are presented first, followed by client- and Site-specific procedures. Lastly, activity-specific procedures are discussed. These Site and activity-specific procedures supplement the general safety procedures included in Roux's Corporate Health and Safety Manual, which also must be followed in their entirely.

7.1 Training

At a minimum, Site personnel who will perform work in areas where there exists the potential for toxic exposure will be health and safety-trained prior to performing work onsite per OSHA 29 CFR 1910.120(e) and 29 CFR 1926.65(e). More specifically, all Roux, subcontractor, and other personnel engaged in sampling and remedial activities at the Site and who are exposed or potentially exposed to hazardous substances, health hazards, or safety hazards must have received at a minimum the 40 hour initial HAZWOPER training consistent with the requirements of 29CFR 1910.120(e)(3)(i) training and a minimum of 3 days' actual field experience under the direct supervision of a trained experienced supervisor, plus 8 hours of refresher training on an annual basis. Depending on tasks performed, less training may be permitted. Evidence of such training must be maintained at the Site at all times. Furthermore, all onsite management and supervisory personnel directly responsible for or who supervise the employees engaged in Site remedial operations, must have received an additional 8 hours of specialized training at the time of job assignment on topics including, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques, plus 8 hours of refresher training on an annual basis.

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

7.2 Site-Specific Safety Briefings for Visitors

A Site-specific briefing is provided to all site visitors who enter this Site beyond the Site entry point. For visitors, the Site-specific briefing provides information about Site hazards, the Site lay-out including work zones and places of refuge, the emergency alarm system and emergency evacuation procedures, and other pertinent safety and health requirements as appropriate.

7.3 HASP Information and Site-Specific Briefings for Workers

Site personnel review this HASP and are provided a Site-specific tailgate briefing prior to the commencement of work to ensure employees are familiar with this HASP and the information and requirements it contains, as well as the relevant JSAs included in **Appendix A**. Additional briefings are provided as necessary to notify employees of any changes to this HASP as a result of information gathered during on-going Site characterization and analysis of changing conditions. Conditions for which we schedule additional briefings include, but are not limited to: changes in site conditions, changes in the work schedule/plan, newly discovered hazards, and incidents occurring during Site work.

7.4 Medical Surveillance

The medical surveillance section of the HASP describes how worker health status is monitored at this Site. Medical surveillance is used when there is the potential for worker exposure to hazardous substances at levels above OSHA permissible exposure limits or other published limits. The purpose of a medical surveillance program is to medically monitor worker health to ensure that personnel are not adversely affected by Site hazards. The provisions for medical surveillance at this Site are based on the Site characterization and job hazard analysis found in Section 4 of this HASP and are consistent with OSHA requirements in 29 CFR 1910.120(f) as applicable.

7.4.1 Site Medical Surveillance Program

Medical surveillance requirements are based on a worker's potential for exposure as determined by the Site characterization and job hazard analysis documented in Section 4 and JSAs within **Appendix A** of this HASP and in compliance with the requirements of 29 CFR 1910.120(f)(2). Based on Site information and use of direct reading instruments, limited use of respirators (less than 30 days per year), and the absence of an employee-staffed hazardous materials (HAZMAT) team, a limited medical surveillance program is required and implemented at this Site. The medical surveillance program provides that:

1. Workers assigned to tasks requiring the use of respirators receive medical examinations in accordance with 29 CFR 1910.134(e) to ensure they are physically capable to perform the work and use the equipment, and
2. If a worker is injured, becomes ill, or develops signs or symptoms of possible over-exposure to hazardous substances or health hazards, medical examinations are provided to that worker as soon as possible after the occurrence and as required by the attending physician.
3. These medical examinations and procedures are performed by or under the supervision of a licensed physician and are provided to workers free of cost, without loss of pay, and at a reasonable time and place. In addition, the need to implement a more comprehensive medical surveillance program will be re-evaluated after any apparent over-exposure.

7.4.2 Medical Recordkeeping Procedures

Medical recordkeeping procedures are consistent with the requirements of 29 CFR 1910.1020 and are described in the company's overall safety and health program. A copy of that program is available at our Islandia, New York office.

The following items are maintained in worker medical records:

- Respirator fit test and selection;
- Physician's medical opinion of fitness for duty (pre-placement, periodic, termination);
- Physician's medical opinion of fitness for respirator protection (pre-placement, periodic); and
- Exposure monitoring results.

7.4.3 Program Review

The medical program is reviewed to ensure its effectiveness. The CHSM in coordination with the Human Resources Director is responsible for this review. At minimum, this review consists of:

- Review of accident and injury records and medical records to determine whether the causes of accidents and illness were promptly investigated and whether corrective measures were taken wherever possible;

- Evaluation of the appropriateness of required medical tests based on Site exposures; and
- Review of emergency treatment procedures and emergency contacts list to ensure they were Site-specific, effective, and current.

7.5 Personnel Protection

Site safety and health hazards are eliminated or reduced to the greatest extent possible through engineering controls (ECs) and work practices. Where hazards are still present, a combination of ECs, work practices, and PPE are used to protect employees. Appropriate PPE shall be worn by Site personnel when there is a potential exposure to chemical hazards or physical hazards (e.g., falling objects, flying particles, sharp edges, electricity, and noise), as determined by the SHSO. The level of personal protection, type and kind of equipment selected will depend on the hazardous conditions and in some cases cost, availability, compatibility with other equipment, and performance. An accurate assessment of all these factors will be made before work can be safely executed.

Roux maintains a comprehensive written PPE program that addresses proper PPE selection, use, maintenance, storage, fit, and inspection. Roux's PPE program can be found within **Appendix E**. PPE to be used at the Site will meet the appropriate American National Standards Institute (ANSI) standards and the following OSHA (General/Construction Industry) standards for minimum PPE requirements.

The minimum level of PPE for entry onto the Site is Level D. The following equipment shall be worn:

- Work uniform (long pants, sleeved shirt);
- Hard hat;
- Steel or composite toe work boots;
- Safety Glasses (must comply with one of the following ANSI/ISEA Z87.1-2010, ANSI Z87.1-2003, ANSI Z87.1-2003);
- Boot Covers (as needed);
- Hearing protection (as needed);
- High visibility clothing (shirt/vest); and
- Hand protection (e.g., minimum cut resistance meeting ANSI 105-2000 Level 2).

Note that jewelry shall be removed or appropriately secured to prevent it from becoming caught in rotating equipment or unexpectedly snagged on a fixed object (e.g., wrist watches, bracelets, rings, chains and necklaces, open earrings). Do not wear loose clothing and all shoulder-length hair should be tied back.

Site specific PPE ensembles and materials are identified within task specific JSAs located within **Appendix A**, and any upgrades or downgrades of the level of protection (i.e., not specified in the JSA) must be approved by the PP and immediately communicated to all Roux personnel and subcontractors as applicable. PPE is used in accordance with manufacturer's recommendations.

7.5.1 Hearing Conservation

Hearing protection is made available when noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 dBA. Hearing protection is required when the 8-hour time weighted average sound level ≥ 90 dBA. Where noise exposure meets or exceeds this level, noise is listed as a physical hazard in the JSA for the tasks/operation, and hearing protection is included as one of the control measures.

7.6 Air Monitoring

In accordance with the DER-10 Technical Guidance for Site Investigation and Remediation dated May 2010 (DER-10) issued by the NYSDEC, a community air monitoring plan (CAMP) will be implemented during intrusive Site activities. The CAMP for the Site is included in **Appendix F** of this HASP. A CAMP is important to the safety of onsite and offsite personnel and the surrounding area. A preliminary survey, to establish background conditions in the immediate sampling area, may be made prior to the initiation of Site work including, but not limited to, monitoring wind direction (e.g., windsocks) and approximate temperature during all invasive Site activities. This survey will be conducted with the appropriate pre-calibrated air monitoring instrument(s), as warranted by the field activity. Once this survey has been completed, any changes in the type of warranted PPE will be determined and relayed to those working onsite.

Work zone and community air monitoring will be performed to verify that the proper level of PPE is used, and to determine if increased protection or work stoppage is required. The following equipment shall be used to monitor conditions:

- PIDs, each with a lamp energy of 10.6 eV will be used to provide direct readings of organic vapor concentrations during intrusive activities to determine that personnel protection is adequate. Concentrations shall be recorded during intrusive activities with the potential to encounter contaminant vapors.
- Dust monitors to monitor for exceedances of dust particulates in the air that may impact workers and travel offsite. Monitors will record data during intrusive activities to determine that personnel protection is adequate and is not impacting other properties. Concentrations shall be recorded during intrusive activities with the potential to generate dust.

Below are monitoring action levels for Site-specific chemicals of concern. In the event PID readings above the thresholds identified below are sustained for 5 minutes in the breathing zone, worker protection will require upgrading following notification to the OHSM and applicable parties (e.g., client, board of health, regulators, etc.).

7.6.1 Action Levels for Air Monitoring

PPE can remain at Level D if breathing zone VOC concentrations are less than 5 parts per million (ppm) and benzene is non-detect. Personnel are required to evacuate the Site when breathing zone VOC readings exceed 25 ppm.

The following tables include summaries of the air monitoring, work practices, and action levels for the expected contaminants. The action levels to initiate testing with colorimetric tubes for airborne volatiles is 1 ppm (PID reading) and is based on the Permissible Exposure Limit (PEL) for benzene (1 ppm). The colorimetric tubes are used to confirm the presence or absence of specific constituents, and they do not provide a measured concentration.

Air Monitoring Summary and Action Levels
Organic Vapors

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

[1] Based on relative response/sensitivity of PID to benzene.
[2] Background concentrations should be established at the beginning of each workday. It may be necessary to re-establish background concentrations and ambient conditions vary through the day.
[3] Measured air concentrations of known organic vapors will be reduced by the respirator to one half of the PEL or lower, and the individual and combined compound concentrations shall be within the service limit of the respirator cartridge.

Action levels for PID readings and dust monitors regarding the CAMP are included in **Appendix F**.

7.6.2 Air Monitoring Equipment and Calibration

A PID calibrated to an appropriate calibration mixture will be used to detect organic vapors in and around the work areas. Monitoring will be conducted in and around all work areas and at the workers breathing zone before activities commence to establish a background level, then at 15-minute intervals throughout the day. All equipment will be calibrated according to the manufacturer's recommendation. A calibration log will be maintained and will include the name of the person who performed the calibration, the date and time calibrated, and the instrument reading at the time of calibration. A manual bellows pump or equivalent with colorimetric tubes for formaldehyde will be utilized to determine the course of action related to upgrading or downgrading the level of respiratory protection, as applicable.

If air monitoring data indicate safe levels of potentially harmful constituents at consistent intervals (5-minute intervals), then monitoring can be conducted less frequently (every 30 minutes). This determination will be made by the onsite SHSO. Monitoring data, including background readings and calibration records, will be documented. Work to be performed onsite will conform to Roux's Standard Operating Procedures (SOPs). Conformance with these guidelines as well as the guidelines described in this HASP will aid in mitigating the physical and chemical hazards mentioned throughout this HASP.

7.7 Tailgate Safety Meetings

A designated Site worker will provide daily safety briefings (e.g., tailgate meetings) including, but not limited to, the following scenarios:

- When new operations are to be conducted;
- Whenever changes in work practices must be implemented; and
- When new conditions are identified and/or information becomes available.

Daily safety briefings shall be recorded on the Roux Daily Tailgate Health and Safety Meeting Log/Daily Site Safety Checklist, and all completed forms will become a part of the project file.

7.8 Spill Containment

Spill containment equipment and procedures should, at a minimum, meet the requirements of the facility's Spill Prevention, Control, and Countermeasure Plan, if applicable. Otherwise, spill containment equipment and procedures must be considered depending on the task including, but not limited to, chemical/product transfer points and handling.

7.8.1 Initial Spill Notification and Response

Any worker who discovers a hazardous substance spill will immediately notify the PP, Frank Cherena. The worker will, to his/her best ability, report the hazardous substance involved, the location of the spill, the estimated quantity of material spilled, the direction/flow of the spill material, related fire/explosion incidents, and any associated injuries without compromising their own safety.

7.8.2 Spill Evaluation and Response

The PP, Frank Cherena, is responsible for evaluating spills and determining the appropriate response. When this evaluation is being made, the spill area will be isolated and demarcated to the extent possible. If necessary to protect nearby community members, notification of the appropriate authorities is made by the PM as appropriate. Onsite response is limited to small spills (e.g., <10 gallons); large spills require external emergency responders who will be contacted by the SHSO.

7.9 Decontamination

The decontamination section of the HASP describes how personnel and equipment are decontaminated when they leave the EZ. This section also describes how residual waste from decontamination processes is disposed. The Site decontamination procedures are designed to achieve an orderly, controlled removal or neutralization of contaminants that may accumulate on personnel or equipment. These procedures minimize worker contact with contaminants and protect against the transfer of contaminants to clean areas of the Site and offsite. They also extend the useful life of PPE by reducing the amount of time that contaminants contact and can permeate PPE surfaces. Decontamination is facilitated within the CRZ at this Site, if applicable.

7.9.1 Decontamination Procedures for Personnel and PPE

The following are general decontamination procedures established and implemented at this Site.

1. Decontamination is required for all workers exiting a contaminated area. Personnel may re-enter the SZ only after undergoing the decontamination procedures described below in the next section.
2. Protective clothing is decontaminated, cleaned, laundered, maintained, and/or replaced as needed to ensure its effectiveness.
3. PPE used at this Site that requires maintenance or parts replacement is decontaminated prior to repairs, or
4. PPE used at this Site is decontaminated or prepared for disposal on the premises. Personnel who handle contaminated equipment have been trained in the proper means to do so to avoid hazardous exposure.
5. This Site uses an offsite laundry for decontamination of PPE. The Site has informed that facility of the hazards associated with contaminated PPE from this Site.

6. The Site requires and trains workers that if their permeable clothing is splashed or becomes wetted with a hazardous substance, they will immediately exit the work zone, perform applicable decontamination procedures, shower, and change into uncontaminated clothing.
7. Procedures for disposal of decontamination waste meet applicable local, State, and Federal regulations.

7.9.2 Decontamination Procedures for Equipment

All tools, equipment, and machinery from the EZ or CRZ are decontaminated in the CRZ prior to removal to the SZ. Equipment decontamination procedures are designed to minimize the potential for hazardous skin or inhalation exposure and to avoid cross-contamination and chemical incompatibilities.

General Equipment Decontamination Procedures:

1. Decontamination is required for all equipment exiting a contaminated area. Equipment may re-enter the SZ only after undergoing the equipment decontamination procedures.
2. Vehicles that travel regularly between the contaminated and clean areas of the Site are carefully decontaminated each time they exit the EZ and the effectiveness of that decontamination is monitored to reduce the likelihood that contamination will be spread to other parts of the Site.
3. Particular attention is given to decontaminating tires, scoops, and other parts of heavy equipment that are directly exposed to contaminants and contaminated soil.

The following items may be used to decontaminate equipment:

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

7.9.3 Monitoring the Effectiveness of Decontamination Procedures

Visual examination and sampling are used to evaluate the effectiveness of decontamination procedures. Visual examination is used to ensure that procedures are implemented as described and that they appear to control the spread of contaminants under changing Site conditions. Visual examination is also used to inspect for signs of residual contamination or for contaminant permeation of PPE.

Personnel who work in contaminated areas of the site, either the CRZ or the EZ, are trained in the principles and practices of decontamination described in this section of the HASP and in related SOPs. If Site procedures are changed as a result of inspection and monitoring, all affected employees are notified of these changes.

7.10 Confined Space Entry

The following is a list of the safety requirements for confined space entry at the Site:

- **ROUX PERSONNEL ARE NOT AUTHORIZED TO ENTER AN OSHA PERMIT-REQUIRED CONFINED SPACE;**
- Currently the SOW DOES NOT require personnel to enter permitted confined space for this project; and

- Any changes to the field activities that may necessitate confined space entry will be reported to the PP and OHSM.

Confined space is defined as any space, depression, or enclosure that:

- Has limited opening for entry and egress;
- Is large enough for and employee to enter and perform assigned work; and
- Is not intended for continuous occupancy.

A permit required confined space is one that meets the definition of a confined space and has one or more of the following characteristics:

- May contain or produce life-threatening atmospheres due to oxygen deficiency or the presence of toxic, flammable, or corrosive contaminants;
- Contains a material that has the potential for engulfment;
- Has an internal configuration that may cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; and
- Contains any other serious health or safety hazards.

Although Roux personnel will not perform confined space entry, it is expected that subcontractors performing cleaning and mitigation and/or remedial measures activities may be required to enter structures that are considered to be a permit-required confined space. Permitting of the confined space as well as hazard mitigation for entry will be completed by the subcontractor in accordance with 1910.146.

7.11 Client and Site-Specific

In addition to the OSHA-specific procedures discussed above, there may be client and site-specific safety procedures that must be adhered to during the performance of remedial activities at the Site.

7.12 Unusual or Significant Risks

Field activities that appear to have unusual or significant risks that cannot be adequately managed with existing risk tools such as Loss Prevention System (LPS), HASPs, traffic safety plans, work permits, design and operation and maintenance (O&M) practices, equipment hazardous operations (HAZOPS), or other safety tools must be referred to the CHSM to help with the assessment and management of the associated potential safety risks. Examples include the use of explosives for demolition, use of firearms to control wildlife, rappelling, demolition over water, diving, etc.

7.13 Activity-Specific Hazards

In addition to the general hazards discussed above, there are activity-specific hazards associated with each work activity planned for the Site. An activity-specific JSA has been completed for each of the activities planned for the Site. JSAs are provided in **Appendix A**. In the event that new work activities or tasks are planned, JSAs will be developed and implemented prior to performing the new activities. In the absence of a JSA, the personnel performing work must prepare a field JSA and receive clearance from a designated competent safety official prior to performing any task with significant risk. In emergency situations where time is critical self-performance safety analyses (SPSAs) will be utilized to identify the task, associated hazards and mitigative actions to take. For lower risk activities (as deemed by the discretion of a Competent

Person) where a JSA is determined to not be needed, the individual(s) conducting the activities must perform SPSAs prior to and during the work.

7.13.1 Electrical and Other Utility Assessment and Accommodations

Roux shall perform a Site walk to identify any potential overhead electrical or utility lines. All applicable guidelines will be followed in the vicinity of overhead power and utility lines (see Section 7.13.3 below).

7.13.2 Subsurface Work

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

7.13.2.1 Excavations and Trenching

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

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

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

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

Maximum Allowable Slopes

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

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

Notes:

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

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

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

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

7.13.3 Heavy Equipment

Use of heavy equipment at the Site will require adherence to Roux's Corporate Heavy Equipment Exclusion Zone Management Program found within **Appendix H**. Additionally, operation of the drill rig/other heavy equipment will maintain clearances from overhead power lines in accordance with OSHA 29 CFR1926.1408 Table A Minimum Clearance Distances provided below.

Minimum Required Clearances for Energized Overhead Power Lines

Nominal System Voltage of Power Line (K V)	Minimum Required Clearance (feet)
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

1 kilovolt (KV) = 1,000 volts

7.14 Heat Stress

Over the course of the year, the temperature in Brooklyn, New York typically varies from approximately 28 to 84 degrees Fahrenheit during the year.

7.14.1 Heat Stress

Heat stress is a significant potential hazard and can be associated with heavy physical activity and/or the use of PPE in hot weather environments. Heat cramps are brought on by prolonged exposure to heat. As an individual sweats, water and salts are lost by the body resulting in painful muscle cramps. The signs and symptoms of heat stress are as follows:

- Severe muscle cramps, usually in the legs and abdomen;
- Exhaustion, often to the point of collapse; and
- Dizziness or periods of faintness.

First aid treatment includes, but is not limited to, shade, rest, and fluid replacement. Typically, the individual should recover within one-half hour while being monitored constantly. If the individual has not improved substantially within 30 minutes and the body temperature has not decreased, the individual should be transported to a hospital for medical attention.

7.14.2 Heat Exhaustion

Heat exhaustion may occur in a healthy individual who has been exposed to excessive heat while working or exercising. The circulatory system of the individual fails as blood collects near the skin to rid the body of excess heat through transference. The signs and symptoms of heat exhaustion are as follows:

- Rapid and shallow breathing;
- Weak pulse;
- Cold and clammy skin with heavy perspiration;
- Skin appears pale;
- Fatigue and weakness;
- Dizziness; and
- Elevated body temperature.

First aid treatment includes, but is not limited to, cooling the victim, elevating the feet, and replacing fluids.

If the individual is not substantially improved within 30 minutes and the body temperature has not decreased, the individual should be transported to the hospital for medical attention.

7.14.3 Heat Stroke

Heat stroke occurs when an individual is exposed to excessive heat and stops sweating. This condition is classified as a MEDICAL EMERGENCY requiring immediate cooling of the victim and transport to a medical facility. The signs and symptoms of heat stroke are as follows:

- Dry, hot red skin;
- Body temperature approaching or above 105 degrees F;
- Confusion, altered mental state, slurred speech;
- Seizures;
- Large (dilated) pupils; and
- Loss of consciousness – the individual may go into a coma.

First aid treatment requires immediate cooling and transportation to a medical facility. Heat stress is a significant hazard if any type of PPE (semi-permeable or impermeable) that prevents evaporative cooling is worn in hot weather environments.

7.15 Cold Stress

Cold stress is a danger at low temperatures and when the wind-chill factor is low. Prevention of cold-related illnesses is a function of whole-body protection. Adequate insulating clothing must be used when the air temperature is below 60°F. A work/rest regimen will be initiated when ambient temperatures and protective clothing cause a stressful situation. In addition, reduced work periods followed by rest in a warm area may be necessary in extreme conditions. The signs and symptoms of cold stress include the following:

- Severe shivering;
- Abnormal behavior;

- Slowing;
- Weakness;
- Stumbling or repeated falling;
- Inability to walk;
- Collapse; and/or
- Unconsciousness.

First aid requires removing the victim from the cold environment and seeking medical attention immediately. Also, prevent further body heat loss by covering the victim lightly with blankets. Do not cover the victim's face. If the victim is still conscious, administer hot drinks and encourage activity such as walking, while wrapped in a blanket.

8. Field Team Review

Each person performing work at or visiting this site shall sign this section after Site-specific training is completed and before being permitted to access the CRZ or EZ.

I have read and understand this Site-Specific HASP. I will comply with the provisions contained therein.

Site/Project: Former Bush Terminal, 5102 1st Avenue, Brooklyn, New York

Name & Company	Signature	Date

9. Approvals

By their signature, the undersigned certify that this HASP is approved and will be utilized at the Former Bush Terminal, 5102 1st Avenue Site.

Lauren Dolginko
Lauren Dolginko – Site Health and Safety Officer

10/1/2021
Date

Kristina DeLuca
Kristina DeLuca - Office Health and Safety Manager

10/1/2021
Date

Lauren Dolginko
Lauren Dolginko – Project Manager

10/1/2021
Date

Frank Cherena
Frank Cherena – Project Principal

10/1/2021
Date

TABLE

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

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site, 5102 1st Avenue, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Acenaphthene	83-32-9	None established	None established	None established	None established	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system	Eyes, skin, respiratory system	Brown solid
Acenaphthylene	208-96-8	None Established	None established	None established	None established	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory system	Eyes, skin, respiratory system	Yellow Solid Fl. Pt.=251°F
Arsenic (inorganic)	7440-38-2 (metal)	TWA 0.01 mg/m3	Ca C 0.002 mg/m3 [15-min]	TWA 0.010 mg/m3	Ca [5 mg/m3 (as As)]	Inhalation; ingestion; skin absorption; skin and/or eye contact	Ulceration of nasal septum, dermatitis, GI disturbances, peripheral neuropathy, resp irritation, hyperpigmentation of skin, [potential occupational carcinogen]	Liver, kidneys, skin, lungs, lymphatic sys	Metal: sliver-gray or tin-white, brittle, odorless solid BP: sublimes
Barium	7440-39-3	TWA 0.5 mg/m3	None established	TWA 0.5 mg/m3	None established	Inhalation, ingestion, skin contact	Irritation skin, respiratory system, digestive system	Skin, eyes, respiratory system	Yellow white powder BP: 1640 C
Benzene	71-43-2	TWA 0.5 ppm STEL 2.5 ppm	Ca TWA 0.1 ppm STEL 1 ppm	TWA 1 ppm ST 5 ppm	Ca [500 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]	Eyes, skin, respiratory system, blood, central nervous system, bone marrow	Colorless to light yellow liquid with an aromatic odor [Note: Solid below 42 °F] BP: 176°F Fl.Pt. = 12°F LEL: 1.2% UEL: 7.8% Class B Flammable liquid
Benzo[a]anthracene	56-55-3	None established [skin cancer]	None established	None established	None established	Inhalation; ingestion; skin absorption; skin and/or eye contact	Irritation eyes, skin, respiratory system, CNS; skin cancer	Skin	Pale Yellow crystal, solid BP: 438 C
Benzo[a]pyrene	50-32-8	None established [cancer]	TWA 0.1 mg/m3	TWA 0.2 mg/m3	None established	Inhalation; ingestion; skin absorption; skin and/or eye contact	POISON. This material is an experimental carcinogen, mutagen, tumorigen, neoplastigen and teratogen. It is a probable carcinogen in humans and a known human mutagen. IARC Group 2A carcinogen. It is believed to cause bladder, skin and lung cancer. Exposure to it may damage the developing fetus. May cause reproductive damage. Skin, respiratory and eye irritant or burns.	Skin, eye, bladder, lung, reproductive	Yellow crystals or powder [found in cigarette smoke, coal tar, fuel exhaust gas and in many other sources] BP: 495 C
Benzo[b]fluoranthene	205-99-2	None established [cancer]	TWA 0.1 mg/m3	TWA 0.2 mg/m3	None established	Inhalation; ingestion; skin and/or eye contact	No data were identified on the toxicity of benzo[b]fluoranthene to humans. Based on results of studies in animals, IARC concluded that benzo[b]fluoranthene is possibly carcinogenic to humans	Respiratory system, skin, bladder, kidneys	Off-white to tan powder
Benzo[k]fluoranthene	207-08-9	None established	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory tract, gastrointestinal; fatal if swallowed, inhaled, absorbed through the skin; vomiting, nausea, diarrhea	Lungs, respiratory system	Yellow crystals BP: 480 C
Benzo(g,h,i)perylene	191-24-2	None established	None established	California permisible exposure limits for chemical contaminants (Title 8, Article 107) PEL 0.2 mg/m3	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, respiratory tract, very toxic to aquatic life with long lasting effects	Eyes, skin, respiratory system	Pale Yellow -Green Crystals BP: 550°C
Beryllium	7440-41-7 (metal)	TWA 0.00005 mg/m^3	Ca C 0.0005 mg/m^3	TWA 0.002 mg/m^3 C 0.005 mg/m^3 (30 minutes) with a maximum peak of 0.025 mg/m^3	Ca [4 mg/m^3 (as Be)]	inhalation, skin and/or eye contact	Berylliosis (chronic exposure): anorexia, weight loss, lassitude (weakness, exhaustion), chest pain, cough, clubbing of fingers, cyanosis, pulmonary insufficiency; irritation eyes; dermatitis; [potential occupational carcinogen]	Eyes, skin, respiratory system	Metal: A hard, brittle, gray-white solid. BP: 4532°F
Cadmium	7440-43-9 (metal)	TWA 0.01 mg/m^3	Ca	TWA 0.005 mg/m^3	Ca [9 mg/m^3 (as Cd)]	inhalation, ingestion	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	respiratory system, kidneys, prostate, blood	Metal: Silver-white, blue-tinged lustrous, odorless solid. BP: 1409°F
Carbon Tetrachloride	56-23-5	TWA 5 ppm STEL 10 ppm	Ca ST 2 ppm (12.6 mg/m3) [60 minute]	TWA 10 ppm C 25 ppm 200 ppm (5-minute maximum peak in any 4 hours)	Ca [200 ppm]	inhalation, skin absorbtion, ingestion, skin and/or eye contact	irritation eyes, skin; central nervous system depression; nausea, vomiting; liver, kidney injury; drowsiness, dizziness, incoordination; [potential occupational carcinogen]	central nervous system, eyes, lungs, liver, kidneys, skin	Colorless liquid with a characteristic ether-like odor. BP: 170°F
Carbon Monoxide	630-08-0	TWA 25 ppm	TWA 35 ppm C 200 ppm	TWA 50 ppm	1,200 ppm	inhalation	Carboxyhemogloemia	Blood	Colorless, odorless gas

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site, 5102 1st Avenue, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Chromium	7440-47-3	TWA 0.5 mg/m^3 (metal and Cr III compounds) TWA 0.05 mg/m^3 (water-soluble Cr VI compounds) TWA 0.01 mg/m^3 (insoluble Cr IV compounds)	TWA 0.5 mg/m^3	TWA 1 mg/m^3	250 mg/m^3 (as Cr)	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; lung fibrosis (histologic)	Eyes, skin, respiratory system	Blue-white to steel-gray, lustrous, brittle, hard, odorless solid. BP: 4788°F
Chrysene; Phenanthrene; Pyrene; Coal tar pitch volatiles	65996-93-2	TWA 0.2 mg/m3	Ca TWA 0.1 mg/m^3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m^3 (benzene-soluble fraction)	Ca [80 mg/m^3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	Respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue. Combustible Solids
Coal Tar Pitch Volatiles; Chrysene; Phenanthrene; Pyrene	65996-93-2	TWA 0.2 mg/m^3	Ca TWA 0.1 mg/m^3 (cyclohexane-extractable fraction)	TWA 0.2 mg/m^3 (benzene-soluble fraction)	Ca [80 mg/m^3]	Inhalation, skin and/or eye contact	Dermatitis, bronchitis, [potential occupational carcinogen]	respiratory system, skin, bladder, kidneys	Black or dark-brown amorphous residue. Combustible Solids
1,1-Dichloroethane	75-34-3	TWA 100 ppm	TWA 100 ppm (400 mg/m^3)	TWA 100 ppm (400 mg/m^3)	3000 ppm	inhalation, ingestion, skin and/or eye contact	Irritation skin; central nervous system depression; liver, kidney, lung damage	Skin, liver, kidneys, lungs, central nervous system	Colorless, oily liquid with a chloroform-like odor. BP: 135°F Fl.P: 2°F UEL: 11.4% LEL: 5.4%
1,2-Dichloroethane (Ethylene Dichloride)	107-06-2	TWA 10 ppm	Ca TWA 1 ppm (4 mg/m^3) STEL 2 ppm (8 mg/m^3)	TWA 50 ppm C 100 ppm 200 ppm [5-minute maximum peak in any 3 hours]	Ca [50 ppm]	inhalation, ingestion, skin absorption, skin and/or eye contact	Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen]	Eyes, skin, kidneys, liver, central nervous system, cardiovascular system	Colorless liquid with a pleasant, chloroform-like odor. [Note: Decomposes slowly, becomes acidic & darkens in color.] BP: 182°F Fl.P: 56°F UEL: 16% LEL: 6.2% Class IB Flammable Liquid
1,2-Dichloroethene (total)	540-59-0	TWA 200 ppm	TWA 200 ppm (790 mg/m^3)	TWA 200 ppm (790 mg/m^3)	1000 ppm	inhalation, ingestion, skin and/or eye contact	Irritation eyes, respiratory system; central nervous system depression	Eyes, respiratory system, central nervous system	Colorless liquid (usually a mixture of the cis & trans isomers) with a slightly acrid, chloroform-like odor BP: 118-140°F Fl.P: 36-39°F UEL: 12.8% LEL: 5.6% Class IB Flammable Liquid
cis-1,2-Dichloroethene	156-59-2	TWA 200 ppm	TWA 200 ppm	TWA 200 ppm	None established	inhalation, skin absorption, ingestion	Harmful if swallowed, inhaled, or absorbed through skin. Irritant. Narcotic. Suspected carcinogen	Skin	Colorless liquid BP: 60 C Fl.P: 4 C UEL: 12.8% LEL: 9.7 %
trans-1,2-Dichloroethene	156-60-5	TWA 200 ppm	None established	TWA 200 ppm STEL 250 ppm (skin)	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Narcotic. Irritation eyes, skin, respiratory tract, mucous membrane; CNS depression.	Respiratory tract, mucous membrane, eyes, skin, CNS	Colorless liquid with a fruity pleasant odor BP: 48°C Fl.P 6C UEL: 12.8% LEL: 9.7%
Dibenzo[a,h]anthracene	53-70-3	None established	None established	None established	None established	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin	Eyes, skin; skin photosensitization.	Colorless crystalline powder BP: 524°C
Dibenzofuran	132-64-9								
Diesel Fuel #2	68476-34-6	TWA 100 mg/m^3; Skin notation	None established	Designated as an OSHA Select Carcinogen	None established	ingestion, skin and/or eye contact	Kidney damage; potential lung damage; suspected carcinogen; irritation of eyes, skin, respiratory tract; dizziness, headache, nausea; chemical pneumonitis (from aspiration of liquid); dry, red skin; irritant contact dermatitis; eye redness, pain.	Eyes, skin, kidneys	Clear yellow brown combustible liquid; floats on water; distinct diesel petroleum hydrocarbon odor. BP: 356-716°F Fl.P: 154.4-165.2°F LEL: 0.6% UEL: 7.0%
Ethylbenzene	100-41-4	TWA 20 ppm	TWA 100 ppm (435 mg/m^3) STEL 125 ppm (545 mg/m^3)	TWA 100 ppm (435 mg/m^3)	800 ppm [10%LEL]	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, mucous membrane; headache; dermatitis; narcosis, coma	Eyes, skin, respiratory system, central nervous system	Colorless liquid with an aromatic odor. BP: 277°F Fl.P: 55°F UEL: 6.7% LEL: 0.8% Class IB Flammable Liquid
Fluoranthene	206-44-0	None established	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; possible burns; heart and liver injury, pulmonary edema, respiratory arrest, gastrointestinal disturbances.	Heart, liver, lungs.	Yellow needles.

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site, 5102 1st Avenue, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Fuel Oil #2	68476-30-2	TWA 100 mg/m3; Skin notation	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; CNS effects; nausea, vomiting, headache, cramping, dizziness, weakness, loss of coordination,, drowsiness; kidney, liver damage	Eyes, skin, CNS	Clear or yellow to red oily liquid, kerosene-like odor BP: 347 - 689 °F UEL:5-6% LEL: 0.7-1.0%
Gasoline	8006-61-9	TWA 300 ppm STEL 500 ppm	Carcinogen	None established	Ca [IDLH value has not been determined]	Skin absorption; inhalation; ingestion; skin and/or eye contact	Eyes and skin irritation, mucous membrane; dermatitis; headache; listlessness, blurred vision, dizziness, slurred speech, confusion, convulsions; chemical pneumonitis; possible liver, kidney damage [Potential occupational carcinogen]	Eyes, skin, respiratory system, CNS, Liver, Kidneys	Clear liquid with a characteristic odor, aromatic Fl.Pt. = -45°F LEL = 1.4% UEL = 7.6% Class 1B Flammable Liquid
Hydrogen Sulfide	7783-06-4	TWA 1 ppm STEL 5 ppm	C 10 ppm (15 mg/m^3) [10-minute]	C 20 ppm 50 ppm [10-minute maximum peak]	100 ppm	inhalation, skin and/or eye contact	Irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; gastrointestinal disturbance; liquid: frostbite	Eyes, respiratory system, central nervous system	Colorless gas with a strong odor of rotten eggs. BP: -77°F UEL: 44.0% LEL: 4.0% Flammable Gas
Indeno[1,2,3-cd]pyrene	193-39-5	None established	None established	None established	None established	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; possible human carcinogen (skin); weakness; affect liver, lung tissue, renal tissue; impairment of blood forming tissue	Skin	Fluorescent green-yellow crystalline solid BP: 536 C
Lead (inorganic)	7439-92-1	TWA 0.05 mg/m^3	TWA (8-hour) 0.050 mg/m^3	TWA 0.050 mg/m^3	100 mg/m^3 (as Pb)	inhalation, ingestion, skin and/or eye contact	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension	Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue	A heavy, ductile, soft, gray solid. BP: 3164°F Noncombustible Solid in bulk form
Mercury (organo) alkyl compounds (as Hg)	7439-97-6	TWA 0.01 mg/m^3 STEL 0.03 mg/m^3 [skin]	TWA 0.01 mg/m^3 STEL 0.03 mg/m^3 [skin]	TWA 0.01 mg/m^3 C 0.04 mg/m^3	2 mg/m^3 (as Hg)	inhalation, skin absorption, ingestion, skin and/or eye contact	Paresthesia; ataxia, dysarthria; vision, hearing disturbance; spasticity, jerking limbs; dizziness; salivation; lacrimation (discharge of tears); nausea, vomiting, diarrhea, constipation; skin burns; emotional disturbance; kidney injury; possible teratogenic effects	Eyes, skin, central nervous system, peripheral nervous system, kidneys	Appearance and odor vary depending upon the specific (organo) alkyl mercury compound
Mercury compounds [except (organo) alkyls] (as Hg) Mercury	7439-97-6	TWA 0.025 mg/m^3 (elemental and inorganic forms)	Hg Vapor: TWA 0.05 mg/m^3 [skin] Other: C 0.1 mg/m3 [skin]	TWA 0.1 mg/m^3	10 mg/m^3 (as Hg)	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria	Eyes, skin, respiratory system, central nervous system, kidneys	Metal: Silver-white, heavy, odorless liquid. [Note: "Other" Hg compounds include all inorganic & aryl Hg compounds except (organo) alkyls.] BP: 674°F
Methylene Chloride (Dichloromethane)	75-09-2	TWA 50 ppm, A3 - suspected human carcinogen	Ca	TWA 25 ppm STEL 125 ppm	Ca [2300 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential occupational carcinogen]	Eyes, skin, cardiovascular system, central nervous system	Colorless liquid with a chloroform-like odor BP: 104°F UEL: 23% LEL: 13%
Naphtha (Rubber Solvent)	8030-30-6	None established	TWA 100 ppm (400 mg/m^3)	TWA 100 ppm (400 mg/m^3)	1000 ppm [10%LEL]	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose; dizziness, drowsiness; dermatitis; in animals: liver, kidney damage	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Reddish-brown, mobile liquid with an aromatic odor BP: 320-428°F Fl.P: 100-109°F Class II Combustible Liquid
Naphthalene	91-20-3	TWA 10 ppm [skin]	TWA 10 ppm (50 mg/m^3) STEL 15 ppm (75 mg/m^3)	TWA 10 ppm (50 mg/m^3)	250 ppm	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes; headache, confusion, excitement, malaise (vague feeling of discomfort); nausea, vomiting, abdominal pain; irritation bladder; profuse sweating; jaundice; hematuria (blood in the urine), renal shutdown; dermatitis, optical neuritis, corneal damage	Eyes, skin, blood, liver, kidneys, central nervous system	Colorless to brown solid with an odor of mothballs. BP: 424°F Fl.P: 174°F UEL: 5.9% LEL: 0.9%
Petroleum hydrocarbons(Petroleum distillates)	8002-05-9	None established	TWA 350 mg/m^3 C 1800 mg/m^3 [15 min]	TWA 500 ppm (2000 mg/m^3)	1,100 [10% LEL]	Inhalation; ingestion; skin and/or eye contact	Irritation eyes, skin, nose, throat; dizziness, drowsiness, headache, nausea; dried/cracked skin; chemical pneumonitis	CNS, eyes, respiratory system, skin	Colorless liquid with a gasoline or kerosene-like odor BP: 86-460°F Fl. Pt = -40 to -86°F UEL: 5.9% LEL: 1.1% Flammable liquid
Polychlorinated Biphenyls (PCBs) (Chlorodiphenyl (42% Chlorine))	53469-21-9	TWA 1 mg/m^3	Ca TWA 0.001 mg/m^3	0.5 mg/m^3	5 ppm	Dermal; inhalation; ingestion; skin and/or eye contact	Irritation eyes; chloracne; liver damage; reproductive effects; [potential occupational carcinogen]	Eyes, skin, liver, respiratory system	Colorless to light-colored, viscous liquid, hydrocarbon odor, BP: 617 - 734°F, non-flammable, LEL: NA, UEL: NA
Selenium	7782-49-2	TWA 0.2 mg/m^3	TWA 0.2 mg/m^3	TWA 0.2 mg/m^3	1 mg/m^3 (as Se)	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat; visual disturbance; headache; chills, fever; dyspnea (breathing difficulty), bronchitis; metallic taste, garlic breath, gastrointestinal disturbance; dermatitis; eye, skin burns; in animals: anemia; liver necrosis, cirrhosis; kidney, spleen damage	Eyes, skin, respiratory system, liver, kidneys, blood, spleen	Amorphous or crystalline, red to gray solid. [Note: Occurs as an impurity in most sulfide ores.] BP: 1265°F

Table 1. Toxicological, Physical, and Chemical Properties of Compounds Potentially Present at the Site, 5102 1st Avenue, Brooklyn, New York

Compound	CAS #	ACGIH TLV	NIOSH REL	OSHA PEL	IDLH	Routes of Exposure	Toxic Properties	Target Organs	Physical/Chemical Properties
Silver	7440-22-4 (metal)	TWA 0.1 mg/m^3 (metal, dust, fume) TWA 0.01 mg/m^3 (Soluble compounds, as Ag)	TWA 0.01 mg/m^3	TWA 0.01 mg/m^3	10 mg/m^3 (as Ag)	inhalation, ingestion, skin and/or eye contact	Blue-gray eyes, nasal septum, throat, skin; irritation, ulceration skin; gastrointestinal disturbance	Nasal septum, skin, eyes	Metal: White, lustrous solid BP: 3632°F
Tetrachloroethene	127-18-4	TWA 25 ppm STEL 100 ppm listed as A3, animal carcinogen	Ca Minimize workplace exposure concentrations	TWA 100 ppm C 200 ppm (for 5 minutes in any 3-hour period), with a maximum peak of 300 ppm	Ca [150 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin, nose, throat, respiratory system; nausea; flush face, neck; dizziness, incoordination; headache, drowsiness; skin erythema (skin redness); liver damage; [potential occupational carcinogen]	Eyes, skin, respiratory system, liver, kidneys, central nervous system	Colorless liquid with a mild, chloroform-like odor. BP: 250°F Noncombustible Liquid
Toluene	108-88-3	TWA 20 ppm	TWA 100 ppm (375 mg/m^3) STEL 150 ppm (560 mg/m^3)	TWA 200 ppm C 300 ppm 500 ppm (10-minute maximum peak)	500 ppm	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, nose; lassitude (weakness, exhaustion), confusion, euphoria, dizziness, headache; dilated pupils, lacrimation (discharge of tears); anxiety, muscle fatigue, insomnia; paresthesia; dermatitis; liver, kidney damage	Eyes, skin, respiratory system, central nervous system, liver, kidneys	Colorless liquid with a sweet, pungent, benzene-like odor. BP: 232°F Fl.P: 40°F UEL: 7.1% LEL: 1.1% Class IB Flammable Liquid
1,1,1-Trichloroethane (Methyl Chloroform)	71-55-6	TWA 350 ppm STEL 450 ppm	C 350 ppm (1900 mg/m^3) [15-minute]	TWA 350 ppm (1900 mg/m^3)	700 ppm	inhalation, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, lassitude (weakness, exhaustion), central nervous system depression, poor equilibrium; dermatitis; cardiac arrhythmias; liver damage	Eyes, skin, central nervous system, cardiovascular system, liver	Colorless liquid with a mild, chloroform-like odor. BP: 165°F UEL: 12.5% LEL: 7.5%
Trichloroethene	79-01-6	TWA 10 ppm STEL 25 ppm	Ca	TWA 100 ppm C 200 ppm 300 ppm (5-minute maximum peak in any 2 hours)	Ca [1000 ppm]	inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]	Eyes, skin, respiratory system, heart, liver, kidneys, central nervous system	Colorless liquid (unless dyed blue) with a chloroform-like odor. BP: 189°F UEL(77°F): 10.5% LEL(77°F): 8%
Vinyl Chloride	75-01-4	TWA 1 ppm	Carcinogen	TWA 1 ppm C 5 ppm [15-minute]	Ca [IDLH value has not been determined]	inhalation, skin, and/or eye contact (liquid)	Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]	Liver, central nervous system, blood, respiratory system, lymphatic system	Colorless gas or liquid (below 7°F) with a pleasant odor at high concentrations. BP: 7°F UEL: 33.0% LEL: 3.6% Flammable Gas
Xylene (m, o & p isomers)	108-38-3, 95-47-6, 106-42-3	TWA 100 ppm STEL 150 ppm	TWA 100 ppm (435 mg/m^3)	TWA 100 ppm (435 mg/m^3)	900 ppm	Skin absorption, inhalation, ingestion, skin, and/or eye contact	Irritation eyes, skin, nose, throat; dizziness, excitement, drowsiness, incoordination, staggering gait; corneal vacuolization; anorexia, nausea, vomiting, abdominal pain; dermatitis	Eyes, skin, respiratory system, central nervous system, gastrointestinal tract, blood, liver, kidneys	Colorless liquid with an aromatic odor BP: 282°F, 292°F, 281°F Fl. Pt. 82°F, 90°F, 81°F LEL: 1.1%, 0.9%, 1.1% UEL: 7.0%, 6.7%, 7.0% Class C Flammable Liquid
Zinc Oxide	1314-13-2	TWA 2 mg/m3 STEL 10 mg/m^3	None established	TWA 10 mg/m3 (for zinc oxide fume)	None established	skin and/or eye contact, inhalation, ingestion	Irritation eyes, skin, respiratory tract; gastrointestinal disturbances	Eyes, skin, respiratory system,	Bluish gray solid BP: 1664.6°F Flammable

References

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Proctor, N.H., J.P. Hughes and M.L. Fischman, 1989. Chemical Hazards of the Workplace. Van Nostrand Reinhold. New York.

Sax, N.I. and R.J. Lewis. 1989. Dangerous Properties of Industrial Materials. 7th Edition. Van Nostrand Reinhold. New York.

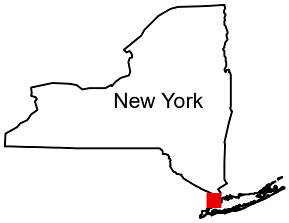
2017 TLVs® and BEIs®, American Conference of Industrial Hygienists

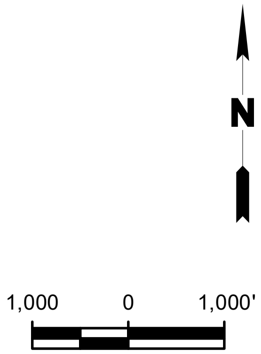
Abbreviations:

ACGIH – American Conference of Governmental Industrial Hygienists.
BP – boiling point at 1 atmosphere, °F
C – Ceiling, is a concentration that should not be exceeded during and part of the working exposure.
CAS# - Chemical Abstracts Service registry number which is unique for each chemical.
Ft Pt. – Flash point
IDLH - Immediately Dangerous to Life and Health concentrations represent the maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.
LEL – Lower explosive (flammable) limit in air, % by volume (at room temperature)
mg/m^3 – Milligrams of substance per cubic meter of air
NIOSH - National Institute for Occupational Safety and Health.
OSHA – Occupational Safety and Health Administration
PEL - OSHA Permissible Exposure Limit (usually) a time weighted average concentration that must not be exceeded during any 8 hour work shift of a 40 hr work week.
ppm – parts per million
REL – NIOSH Recommended Limit indicated a time weighted average concentration that must not be exceeded during any 10 hour work shift of a 40 hr work week
SG - Specific Gravity
STEL – Short-term exposure limit (ST)
TLV - ACGIH Threshold Limit Values (usually 8 hour time weighted average concentrations).
TWA – 8-hour, time-weighted average
UEL – Upper explosive (flammable) limit in air, % by volume (at room temperature)
VP - Vapor Pressure

FIGURES

QUADRANGLE LOCATION





Title:

SITE LOCATION MAP

5102 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL, LLC

ROUX

Compiled by: D.M.	Date: 04/15/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	1
Project Mgr: L.D.	Project: 3454.0001Y000	
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LEGEND

🟥 BCP SITE BOUNDARY

🟨 EMERGENCY MUSTER AREA

200 0 200'

Title:

SITE PLAN WITH EMERGENCY MUSTER AREA

5102 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL, LLC

ROUX

Compiled by: D.M.	Date: 04/15/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	2
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y102.2.mxd		

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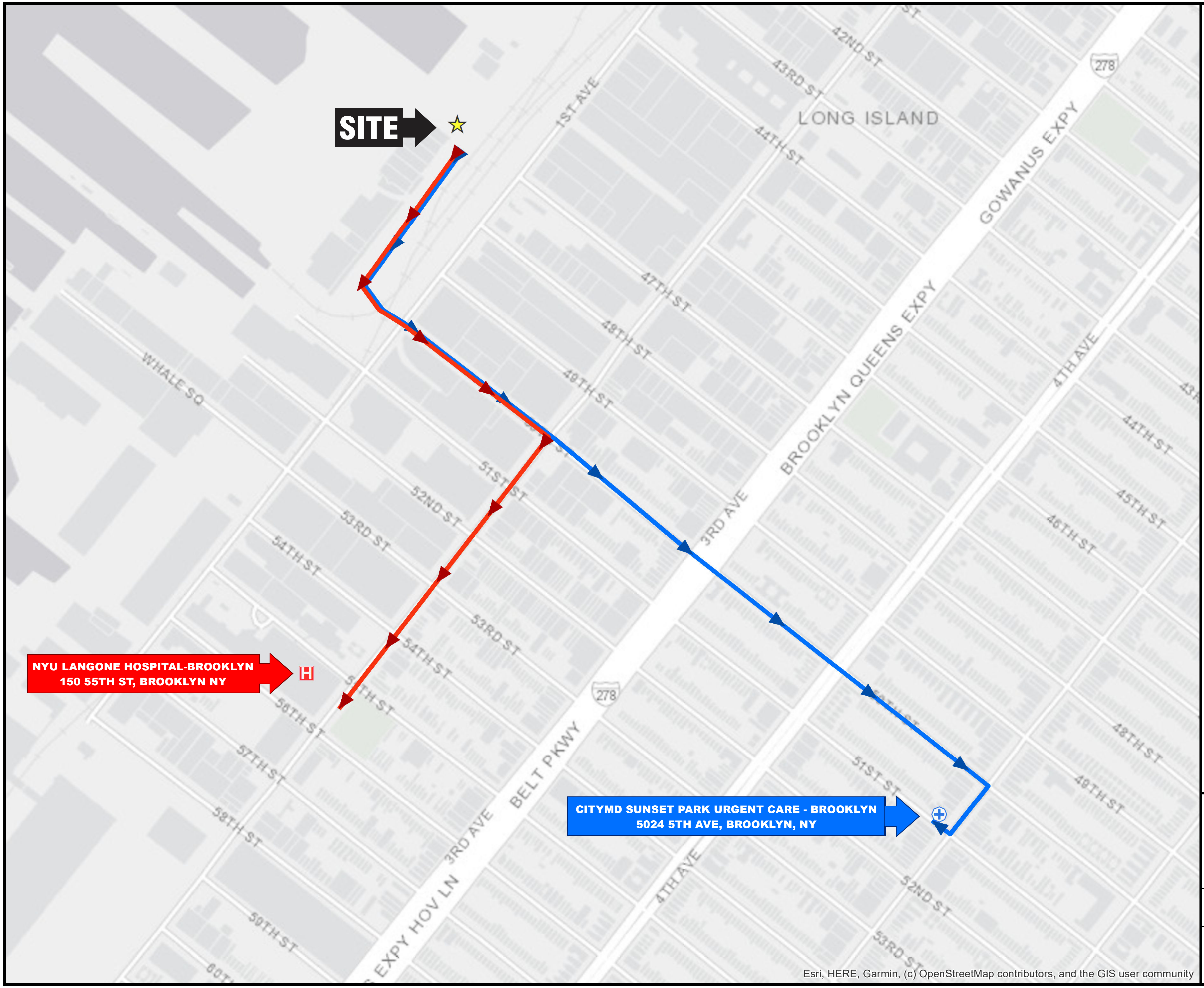

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N

DIRECTIONS TO HOSPITAL

1. HEAD SOUTHWEST ON 50TH ST
2. TURN RIGHT ONTO 2ND AVE
3. DESTINATION WILL BE ON THE RIGHT

DIRECTIONS TO URGENT CARE

1. HEAD SOUTHWEST ON 50TH ST
2. TURN RIGHT ONTO 5TH AVE
3. DESTINATION WILL BE ON THE RIGHT

400 0 400'

Title:

ROUTES TO URGENT CARE AND HOPSITAL

5102 1ST AVENUE
BROOKLYN, NEW YORK

Prepared for:

STEINER SEQUEL, LLC

ROUX

Compiled by: D.M.	Date: 04/15/21	FIGURE
Prepared by: M.S.R.	Scale: AS SHOWN	3
Project Mgr: L.D.	Project: 3454.0001Y000	
File: 3454.0001Y102.3.mxd		

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APPENDICES

A. Job Safety Analysis Forms

B. Safety Data Sheets for Chemicals Used

C. COVID-19 Interim Health and Safety Guidance

D. Incident Investigation and Reporting Management Program

E. Personal Protective Equipment Management Program

F. New York State Department of Health Generic Community Air Monitoring Plan

G. Subsurface Utility Clearance Management Program

H. Heavy Equipment Exclusion Zone Policy

APPENDIX A

Job Safety Analysis Forms

JOB SAFETY ANALYSIS (JSA) MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	**:**	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	**:**	**01/19**
REVISION NUMBER	**:**	**2**

TABLE OF CONTENTS

APPENDICES

Appendix A – Job Safety Analysis Process Flow Chart
Appendix B – Standard Job Safety Analysis Form
Appendix C – Job Safety Analysis Quality Review

1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has established this Job Safety Analysis (JSA) Program to provide practices and procedures to evaluate potential hazards associated with work tasks and develop preventive measures to eliminate and/or reduce the risk of injury/illness to personnel, property damage and/or environmental releases. A hazard is defined as a condition or activity that, if left uncontrolled, can result in an undesired consequence. This program utilizes a proactive and versatile tool, the JSA, which identifies hazards associated with a specific work task and applies mitigative actions to eliminate and/or reduce the hazards to an acceptable risk level. Moreover, the practices and procedures, herein, employ a stewardship approach to ensure that JSA updates are communicated throughout the company and represent best management practices.

2. SCOPE AND APPLICABILITY

The JSA Program applies to all Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) employees and their subcontractors. At a minimum, tasks for which a JSA is required include:

- Field work and processes;
- Non-routine activities;
- Activities that present higher potential for injury or illness;
- Where there has been a history of prior incidents; and/or
- New or modified activities, equipment usage or procedures.

The program is intended, in part, to meet Occupational Safety and Health Administration OSHA’s Voluntary Protection Programs Policies and Procedures and their Job Hazard Analysis manual (Publication 3071, Revised 2002).

3. PROCEDURE

For many tasks, a generic or site-specific JSA may already exist. Generic JSAs can be found in the JSA Library (Clarity→Health and Safety→JSA Library). Site-specific JSAs can be found in the project files. However, prior to use of a generic JSA the following must be verified by the project Manager (PM):

1. The JSA includes all the site-specific (if applicable) job steps for the task;
2. The JSA cannot be combined with job steps from other JSA tasks to be considered as one working document; and
3. There are no equipment/tools changes since the last revision/review.

If the above conditions are met the generic JSA may be used. If the above conditions cannot be satisfied, then a new or revised JSA must be developed for the work task. The development process of a JSA is outlined below and is included as a flow chart as **Appendix A**.

3.1 JSA Process

Development Team

JSAs are developed by an individual or team of people who have conducted the task, are familiar with the JSA process, and have experience in general safety practices. Typically, one of these personnel includes a member of the project management team (e.g., PM, Site H&S Manager (SHSM) and/or the Project Principal). Based on the complexity of the operation, additional team members may be utilized in the development process.

JSA Form

To assist in the development process, a standard JSA form is provided as **Appendix B** of this program. Generic JSAs (available in the JSA Library) may be used as a starting point for similar tasks. In addition to documenting the job steps, potential hazards and mitigative actions (discussed below), the form documents the individuals who developed it, the reviewers and the date of the JSA. JSAs are to be limited to one or two pages. For complex operations where more than two pages may be needed, the job should be broken down into multiple tasks, each task having its own JSA. The steps are described below:

Step 1 – List Job Steps

The first step in developing a JSA is to identify each job step in order of occurrence. Job steps should be concise and clearly describe the individual safety critical tasks for the collective operation. *For example, a monitoring well gauging and sampling task may include the following job steps: 1) access well with hand tools, 2) gauge well using interface* probe, *3) purge well with bailer, etc. Whereas, an example of a job step that is too generalized is "gauge and sample well."*

Step 2 – Identify Potential Hazards

Next, for each job step, determine potential hazards that may exist or occur while performing the associated job step. In helping determine safety critical job steps, the following questions should be assessed:

- "What could go wrong?"
- "What's the Worst that Can Happen?"
- "What are the consequences?"

Potential hazards should be identified by the following categories:

- Contact – struck by or against an object.
- Caught – caught on, in or between objects.
- Falls – slips, trips or falls to the ground or a lower level.
- Exertion – repetitive motion, excessive strain/stress, ergonomics, lifting/bending.
- Exposure – inhalation/ingestion/injection, cold/heat stress, noise/vibration.
- Energy Sources – electric lines or mechanical energy, including stored energy.

For each hazard category, the potential hazard should be further described. Refer to the JSA Quality Review Guidance Document provided as **Appendix C** for examples of potential hazards. *For instance, with the example described in Step 1 above, a potential hazard associated with the monitoring well gauging and sampling task – specifically, the job step to "access well with hand tools" – may include CAUGHT – pinch points when handling well cover.*

Step 3 – Determine Mitigative Actions

After the potential hazard(s) have been identified, evaluate if the job step can be performed in a manner where the hazard is eliminated, reduced or controlled. Common methods to eliminate, reduce or control potential hazards which follow the hierarchy of controls may include, but are not limited to, one or a combination of the following:

- Eliminating or substituting a job step with a less hazardous operation.
- Combining job steps or changing the sequence.
- Instituting engineering controls.
- Obtaining other tools or redesigning equipment.
- Performing ambient monitoring or screening.
- Obtaining additional safety equipment including personal protective equipment (PPE).
- Adding warning devices.

Mitigative actions should be specific and avoid using generalizations such as, "be careful" or "use caution." There must be at least one mitigative action for each potential hazard. PPE should never be the only mitigative action. It is the last line of defense. *Taking the example illustrated in Steps 1 & 2 above, mitigative actions for the potential hazard "CAUGHT – pinch points when handling well cover" may include 1) wear leather gloves, 2) use pry bar when accessing well cover, 3) keep hands/fingers clear between cover and collar, … etc.*

3.2 Review Process

Once a site-specific JSA has been developed, it is then submitted to the PM for review and approval prior to the start of a task. If the PM was involved in the development of the JSA then it will be provided to the OHSM for review and approval. When a quality review of JSAs are conducted by a member of management (e.g., Project Principals, CHSM) the review ensures that, at a minimum, the below "five rules" have been met:

1) JSA never more than 2 pages.

2) JSA authors listed should be people / titles who perform that type of work. Management should be reviewers / approvers.
3) Critical actions are always specific, observable actions – never "proper" or "appropriate" or "careful."
4) PPE is considered a last line of defense and should be included in the critical actions. However, it cannot be the only critical action listed to mitigate a hazard; you must always identify other actions in addition to the applicable PPE (e.g., keep fingers clear of pinch points while closing cover; and wear cut resistant gloves).

In addition, at least annually, the PM and JSA Steward(s) are responsible for reviewing and updating (if necessary) the site-specific and generic JSAs, respectively, for which they are responsible. The review is carried out utilizing the JSA Quality Review Checklist which is provided in **Appendix C**. The JSA Stewards are assigned by the OM/CHSM for specific generic JSAs and are identified within the JSA Steward list posted within the JSA Library. These Stewards are appointed based on their knowledge and experience with specific work tasks. The JSA Library is updated routinely (min quarterly) by the CHSM to ensure that it contains only the most current version of each generic JSA.

3.3 JSA Library

JSA Stewards submit updated generic JSAs to the CHSM for filing in the JSA Library. As part of the annual review process, JSA Stewards must audit the JSA Library to ensure that it contains only the most current version of the JSA for which they are responsible. Approved site-specific JSAs are filed in the project files.

3.4 JSA Updates

JSAs can be updated based on a variety of factors or reasons, such as the examples provided below:

- Identification of inadequate procedures during a safety tailgate meeting.
- A Safe Performance Self-Assessment (SPSA) determining that the task should have a JSA or that procedures within the existing JSA are not adequate to address identified hazards.
- Change in site or environmental conditions.
- New or modified equipment or procedures.
- Observations or incident investigations that identify tasks requiring new or updated JSAs.

Changes to a generic JSA requires submittal and review by the JSA Steward appointed for that task to determine if the genetic JSA change is necessary. If changes are warranted, the JSA Steward forwards the updated generic JSA to the CHSM for review and uploading into the JSA Library.

Changes to Site-specific revisions need only approval from the PM.

3.5 Emergency Situations

In the absence of an existing JSA during an emergency situations, personnel should discuss with both the PM and SHSM the job steps, potential hazards and associated mitigative actions for tasks anticipated to be performed. As conditions, may change during the task(s), the personnel must reassess the job step(s) and potential hazards, and discuss any additional changes with the PM and SHSM prior to resuming the activity. For unplanned activities, it is critical that personnel do not proceed with performing task(s) without prior health and safety consideration and planning.

3.6 Subcontractors

Roux subcontractors are required to submit their JSAs for review in advance of the work. This allows time for Roux's PM to provide comments and suggestions to the subcontractors JSA's. Roux subcontractors should understand that no work may occur unless the JSAs for the work being performed have been reviewed by Roux. JSAs provided by subcontractors are maintained in the project files. For common tasks and to maintain consistency, the project management team may provide a similar or generic approved JSA to a subcontractor for use as a starting point for development of the subcontractors JSA.

Subcontractor JSAs are reviewed in the field daily prior to performing work. Roux oversight personnel and the project management team will assist subcontractors with updating JSAs as described in Section 3.4.

4. TRAINING

Every employee who may perform field work will be trained in this program and the proper use of the JSA. The training includes:

- A review of this Program.
- Development of a JSA.

This training is repeated as necessary to ensure that employees receive reinforcement of the value of the JSA Program as well as feedback on the health of the JSA Program. Office workers may receive training if an anticipated task will be performed that requires development of and training in a JSA.

5. RECORDS

The following records are maintained by the CHSM:

- A library of generic JSAs.
- Copies of all site field audits performed that assist with the evaluation of the effectiveness of the JSA program will be uploaded Quarterly and are located and stored at Clarity→Health & Safety→[Office Specific]→Field Audit Checklist (FAC). Key findings from these field audits will be communicated by the CHSM to OHSM for further communication to the office staff (typically during monthly lunch and learns).

The following record is to be maintained by each PM:

- Each site-specific JSA developed for their project. All JSAs are expected to be included in Appendix A in the project HASP.

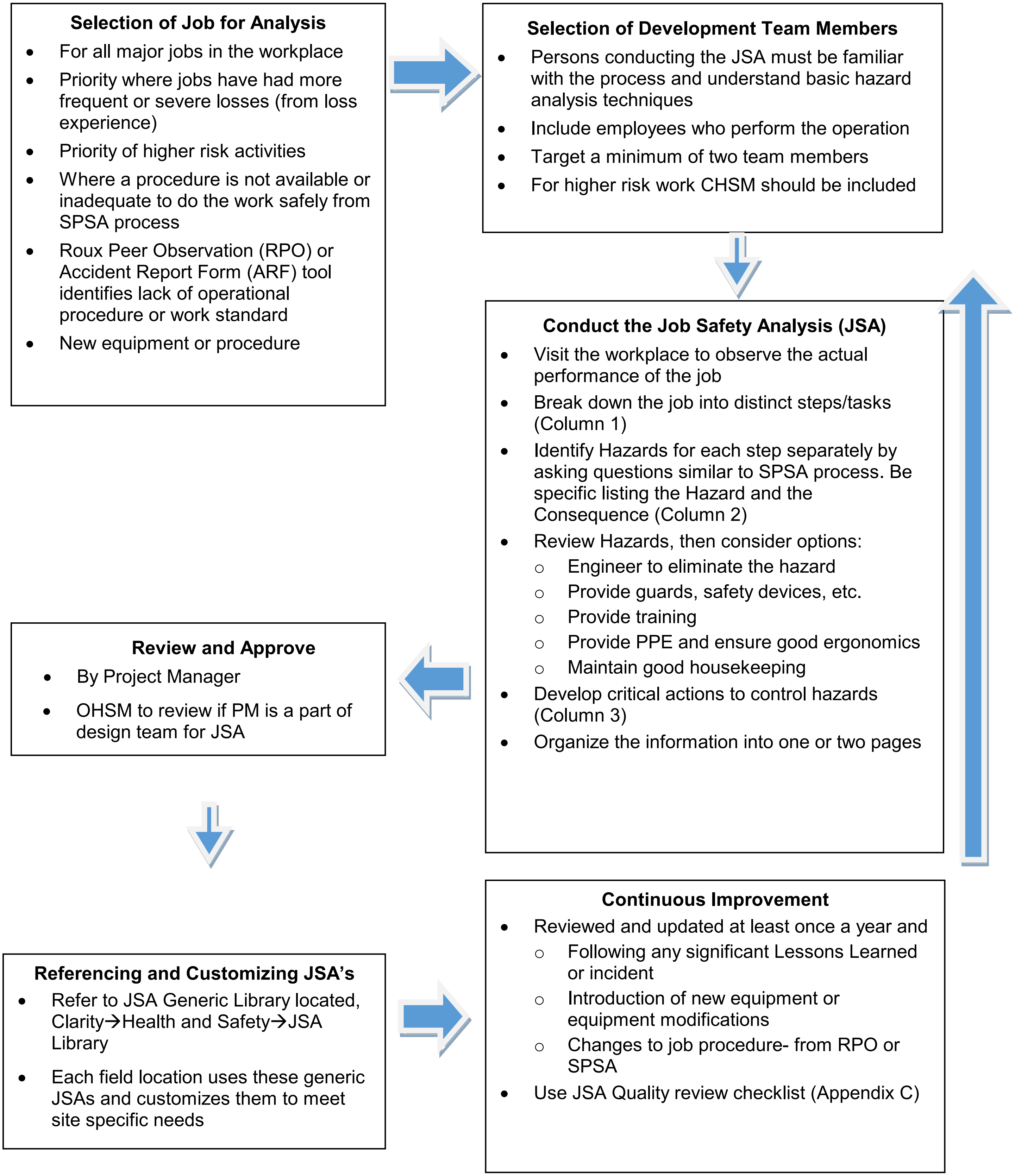
The following record is to be maintained by each JSA Steward:

- The latest version of each generic JSA for which they have been assigned and stored in the JSA Library.

6. PROGRAM EVALUATION

The CHSM will evaluate the program’s effectiveness during field audit(s). The CHSM should, at a minimum assess the overall effectiveness of the JSA Program quarterly. Records shall be maintained within the JSA Library. The assessment will include the adequacy of applicable JSAs and consistency in their use. Program adjustments will be made as necessary to reflect the evaluation results.

Appendix A – Job Safety Analysis Process Flowchart



Selection of Job for Analysis

- For all major jobs in the workplace
- Priority where jobs have had more frequent or severe losses (from loss experience)
- Priority of higher risk activities
- Where a procedure is not available or inadequate to do the work safely from SPSA process
- Roux Peer Observation (RPO) or Accident Report Form (ARF) tool identifies lack of operational procedure or work standard
- New equipment or procedure

Selection of Development Team Members

- Persons conducting the JSA must be familiar with the process and understand basic hazard analysis techniques
- Include employees who perform the operation
- Target a minimum of two team members
- For higher risk work CHSM should be included

Conduct the Job Safety Analysis (JSA)

- Visit the workplace to observe the actual performance of the job
- Break down the job into distinct steps/tasks (Column 1)
- Identify Hazards for each step separately by asking questions similar to SPSA process. Be specific listing the Hazard and the Consequence (Column 2)
- Review Hazards, then consider options:
  - Engineer to eliminate the hazard
  - Provide guards, safety devices, etc.
  - Provide training
  - Provide PPE and ensure good ergonomics
  - Maintain good housekeeping
- Develop critical actions to control hazards (Column 3)
- Organize the information into one or two pages

Review and Approve

- By Project Manager
- OHSM to review if PM is a part of design team for JSA

Referencing and Customizing JSA's

- Refer to JSA Generic Library located, Clarity→Health and Safety→JSA Library
- Each field location uses these generic JSAs and customizes them to meet site specific needs

Continuous Improvement

- Reviewed and updated at least once a year and
  - Following any significant Lessons Learned or incident
  - Introduction of new equipment or equipment modifications
  - Changes to job procedure- from RPO or SPSA
- Use JSA Quality review checklist (Appendix C)

Appendix B - Job Safety Analysis Form

JOB SAFETY ANALYSIS	**Cntrl. No.**	DATE:	☒ NEW ☐REVISED	PAGE 8 of 2
JSA TYPE CATEGORY **GENERIC**		WORK TYPE	WORK ACTIVITY (Description)	
DEVELOPMENT TEAM		**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
	REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT			
☐ LIFE VEST ☐ HARD HAT ☐ LIFELINE / BODY HARNESS ☐ SAFETY GLASSES		☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☐ SAFETY SHOES	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☐ PPE CLOTHING:	☐ GLOVES: ☐ OTHER
	REQUIRED AND / OR RECOMMENDED EQUIPMENT			
	Required Equipment:			
	Commitment to LPS – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.			
	EXCLUSION ZONE: A _ foot exclusion zone will be maintained around (indicate equipment).			
Assess **[1]JOB STEPS**		**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**	
1. [INSERT JOB STEP]		**1a. CONTACT:** [INSERT HAZARD]	1a.	
		1b. CAUGHT: [INSERT HAZARD]	1b.	
		1c. FALL: [INSERT HAZARD]	1c.	
		1d. EXPOSURE: [INSERT HAZARD]	1d.	

		1e. EXERTION: [INSERT HAZARD]	1e.
		1f. ENERGY SOURCE: [INSERT HAZARD]	1f.
2. [INSERT JOB STEP]		**2a. CONTACT:** [INSERT HAZARD]	2a.
		2b. CAUGHT: [INSERT HAZARD]	2b.
		2c. FALL: [INSERT HAZARD]	2c.
		2d. EXPOSURE: [INSERT HAZARD]	2d.
		2e. EXERTION: [INSERT HAZARD]	2e.
		2f. ENERGY SOURCE: [INSERT HAZARD]	2f.

Appendix C - Job Safety Analysis Quality Review

GUIDANCE DOCUMENT

JOB SAFETY ANALYSIS (JSA) QUALITY REVIEW

A Job Safety Analysis (JSA) is both a technique and a tool used to carefully study and record each step of a job or task, identify existing or potential hazards associated with each step and determine the best actions to follow in order to avoid those hazards. The JSA provides a standard for conducting work and Roux Peer Observations (RPOs) and also serves as an excellent safety training and daily site safety meeting reference tool. A JSA is applicable for routine and higher risk activities.

The following guidance provides items a Quality Reviewer should ask about or look for when reviewing and commenting on a JSA. Quality Review feedback should be specific and may be in writing or verbal. Written feedback ensures clear communication and better tracking. Verbal feedback allows discussion and can be conducted at group safety meetings, by telephone, etc. for sharing of learnings as well. Safety stewardship focuses on quality use of the tools and other activities that personnel can control. This guidance applies to all Quality Reviewers from the front-line supervisor to senior management. Feedback on the quality of a JSA should include several items that are done well in addition to areas to improve.

Administrative and Header Information

- Are all sections completed?
- Does header include appropriate information such as name of company who developed JSA, location and work activity JSA applies to, names/titles of development team and quality reviewer(s), and date?
- Does development team include job experts (field personnel who perform the task) along with personnel familiar with hazard analysis techniques, specifically the worker actually completing the task?
- Does PPE section include minimum required specific PPE for task and is it consistent with PPE requirements listed in Column 3?
- Was the JSA reviewed by Roux personnel?
- Is the JSA limited to two pages?
- Is the JSA written in terms that field personnel can follow rather than as a "reference document" written by office staff?

Column 1 Job Steps

- Does the JSA cover one main task and not multiple tasks that should be divided into separate JSAs? Designate job task steps not overall work flow process to complete job.
- Are the job steps clearly defined and in a logical sequence that aligns with how the work is performed in the field?
- Do the job steps only include those with associated SH&E hazards?

Column 2 Potential Hazards

- Are hazards listed to correspond with each job step in Column 1?

- Do the hazards listed consider all potential hazards (e.g. environmental conditions, injurious contact, overexertion, slips/trips/falls, exposure to hazardous materials, traffic, property/environmental impacts, etc.)?
- Are the hazards specifically stated (e.g. instead of stating hazard as "chemical exposure", state "exposure to sulfuric acid from leaking battery")?
- Are there "extra" hazards that do not apply indicating that the JSA may have been developed for another site and not revised to address site-specific hazards?

Column 3 Critical Actions to Mitigate Hazards

- Do the critical actions align horizontally with the job steps and hazards from Columns 1 and 2?
- Are the actions clear and specific? (e.g. "wear a reflective vest and place traffic cones around work area" rather than "watch out for traffic").
- Are the actions quantifiable when possible? (e.g. "use two people to lift objects over 40 pounds" rather than "get help with heavy objects").
- Are the actions observable and objective so that an RPO Observer who is unfamiliar with task can determine if it is being done correctly? (e.g. "maintain three points of contact when climbing ladder" rather than "use safe climbing techniques").
- Do the actions avoid ambiguous phrases such as "use caution", "be careful", "stay alert", "and watch out"?
- Do the actions avoid subjective phrases such as "use proper", "as needed", "as required", "as necessary" that leave it open to individual worker's interpretation of what is required to perform work safely?
- Do not list minimum required PPE without including in the mitigation for this task, think why the PPE is required.
- PPE cannot be the only line of defense, PPE always the last line of defense, so think through what other actions could mitigate hazards.

JSA QUALITY REVIEW CHECKLIST

Reviewer Name / Company / Title:		**Desktop Review?**		**Field Review?**		**Date:**	

Administrative and Header Information	**Yes**	**No**	**Comments**
Is the JSA limited to two pages?			
Are all sections completed?			
Does development team include job experts and personnel familiar with JSA development process?			
Was the JSA reviewed by a supervisor/manager?			
Does PPE section include PPE required for entire task with additional PPE listed in Column 3?			
Is the JSA written in terms that field personnel can follow?			
Column 1 - Job Steps	**Yes**	**No**	**Comments**
Does JSA cover one main job task and not overall work flow process or multiple tasks that should be in standalone JSAs?			
Are job steps clearly defined and in sequence that aligns with how the work is performed?			
Column 2 - Potential Hazards	**Yes**	**No**	**Comments**
Do hazards listed clearly correspond with each job step in Column 1?			
Are the hazards specifically stated (e.g. exposure from (what?), cut from (what?), slip from (what?)?)			
Do the hazards listed include all potential hazards?			
Does JSA avoid "extra" hazards that do not apply (may indicate generic JSA use without site revision)?			
Column 3 - Actions to Mitigate Hazards	**Yes**	**No**	**Comments**
Do the critical actions clearly match each listed hazard and job step from Columns 1 and 2?			
Are the actions clear and specific?			
Are the actions quantifiable when possible (e.g. include number, limit, amount or distance)?			
Are the actions observable and objective (e.g. explain "how to")?			
Do the actions avoid ambiguous phrases (e.g. "be careful", "watch out")?			
Do the actions avoid subjective phrases (e.g. "proper", "appropriate")?			
Additional Comments:			

Quality Review Feedback provided to (name/company):			
Quality Review Feedback Action Item(s)	**Responsible Person**	**Target Completion Date**	**Actual Completion Date**

JOB SAFETY ANALYSIS **Ctrl. No. GEN-006**	DATE 8/6/2018	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **Generic**	WORK TYPE: **Drilling**	WORK ACTIVITY (Description): **Direct Push Soil Borings / Well Installation**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Timothy Zei	Project Hydrogeologist	Raymond Olson	Staff Assistant Geologist
		Christine Pietrzyk	Office Health & Safety Manager
		Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

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

☐ GOGGLES
☐ FACE SHIELD
☒ HEARING PROTECTION: (as needed)
☒ SAFETY SHOES: Composite-toe or steel toe boots

☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing, Long Sleeve Shirt

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

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Geoprobe or Truck-Mounted Direct Push Drill Rig, Hand Tools, Photoionization Detector, Multi-Gas Meter (or equivalent), Macrocore liners, Liner Opening Tool, 20 lb. Type ABC Fire Extinguisher, 42" Cones & Flags, "Work Area" Signs, Water

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

EXCLUSION ZONE (EZ) – All non-essential personnel will maintain a distance of 10 feet from drilling equipment while equipment is moving/engaged

"SHOW ME YOUR HANDS"
Driller and helper should show that hands are clear from controls and moving parts

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Mobilization of drilling rig (ensure the Subsurface Clearance Protocol and Drill Rig Checklist are completed)	**1a. CONTACT:** Equipment/property damage.	1a. The drill rig's tower/derrick will be lowered and secured prior to mobilization. 1a. A spotter should be utilized while moving the drill rig. If personnel move into the path of the drill rig, the drill rig will be stopped until the path is again clear. Use a spotter for all required backing operations. 1a. Set-up the work area and position equipment in a manner that eliminates or reduces the need for backing of support trucks and trailers. 1a. When backing up truck rig with an attached trailer use a second spotter if there is tight clearance simultaneously on multiple sides of the equipment or if turning angles limit driver visibility. 1a. Inspect the driving path for uneven terrain. Level or avoid if needed. 1a. Drill rig should have a minimum **exclusion zone of 10 feet** for non-essential personnel (i.e., driller helper, geologist) when the rig is moving/ in operation.
	1b. FALL: Slip/trip/fall hazards.	1b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 1b. Do not climb over stored materials/equipment; walk around. Practice good housekeeping. 1b. Use established pathways and walk on stable, secure ground.
	1c. CONTACT: Crushing from roll-over.	1c Geoprobe should cross all hills/obstructions head on with the mast down to reduce risk of roll-over.
2. Raising tower/derrick of drill rig	**2a. CONTACT:** Overhead hazards.	2a. Prior to raising the tower/derrick, the area above the drilling rig will be inspected for wires, tree limbs, piping, or other structures, that could come in contact with the rig's tower and/or drilling rods or tools. 2a. Maintain a safe distance of 10' from overhead structures.
	2b. CONTACT: Pinch Points/Amputation Points when raising the rig and instability of rig	2b. Inspect the equipment prior to use and avoid pinch/amputation points. 2b. Lower outriggers to ensure stability prior to raising rig tower/derrick. 2b. If the rig needs to be mounted, be sure to use three points of contact.
3. Advancement of drilling equipment and well installation	**3a. CONTACT:** Flying debris	3a. Be aware of and avoid potential lines of fire and wear required PPE such as eye, ear, and hand protection.
	3b. EXPOSURE: Noise and dust.	3b. Wet borehole area with sprayer to minimize dust. 3b. Stand upwind and keep body away from rig. 3b. Dust mask should be worn if conditions warrant. 3b. Wear hearing protection when the drill rig is in operation.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
3. Advancement of drilling equipment and well installation (Continued)	**3a. CONTACT:** Flying debris **3b. EXPOSURE:** Noise and dust. **3c. FALL:** Slip/trip/fall hazards. **3d. CAUGHT:** Limb/extremity pinching; abrasion/crushing. **3e. CONTACT:** Equipment imbalance during advancement of drill equipment. **3f. EXPOSURE:** Inhalation of contamination/vapors. **3g. EXERTION:** Potential for muscle strain/injury while lifting and installing well casings, lifting sand bags, and/or lifting rods.	3c. Contain drill cuttings and drilling water to prevent fall hazards from developing in work area. 3c. See 1b. 3d. Ensure all Emergency Safety Stop buttons function properly. 3d. Always wear leather gloves when making connections and using hand tools; wear cut-resistant (i.e., Kevlar) gloves when handling cutting tools. 3d. Inspect the equipment prior to use for potential pinch/amputation points. Keep hands away from pinch/amputation points and use of tools is preferable compared to fingers and hands. 3d. Inspect drill head for worn surface or missing teeth; replace if damaged or blunt. 3d. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body. 3d. All non-essential personnel should stay away from the immediate work area; position body out of the line-of-fire of equipment. 3d. Drillers and helpers will understand and use the “Show Me Your Hands” Policy. 3d. Spinning rods/casing have an **exclusion zone of 10 feet** while in operation. 3e. Drillers will advance the borehole with caution to avoid causing the rig to become imbalanced and/or tip. 3e. The blocking and leveling devices used to secure the rig will be inspected by drillers and Roux personnel regularly to see if shifting has occurred. 3e. In addition, personnel and equipment that are non-essential to the advancement of the borehole will be positioned away from the rig at a distance that is at least as far as the boom is high (**minimum exclusion zone of 10 feet**). 3f. Monitor ambient air for dangerous conditions using a calibrated photoionization detector (PID) to periodically monitor the breathing zone of the work area. 3f. If a reading of >5ppm is recorded, the Roux field personnel must temporarily cease work, instruct all Site personnel to step away from the area of elevated readings and inform the Roux PM of the condition. The Roux PM will then recommend additional precautions in accordance with the site specific health and safety plan. 3f. Use a multi-gas meter to monitor ambient air for dangerous conditions (i.e. unsafe levels of carbon monoxide when drilling indoors or the presence of explosive vapors). 3g. Keep back straight and bend at the knees. 3g. Utilize team lifting for objects over 50lbs. 3g. Use mechanical lifting device for odd shaped objects.
4. Remove sample liner.	**4a. EXERTION:** Potential for muscle strain/injury while removing liner from probe rod. **4b. CONTACT:** Pinch points and cuts **4c. EXPOSURE:** Inhalation and/or dermal contact with contaminants.	4a Utilize team lifting for objects over 50lbs. 4a. Use hydraulic liner extruder if available. 4b. Place liner on sturdy surface when opening. 4b. Don cut-resistant gloves and use appropriate liner cutter when opening liners. 4b. Always cut away from the body. 4c. Wear chemical-resistant disposable gloves when handling liners. 4c. See 3e.
5. Decontaminate equipment.	**5a. EXPOSURE/CONTACT**: To contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated groundwater, vapors). **5b. EXPOSURE:** To chemicals in cleaning solution including ammonia.	5a. Wear chemical-resistant disposable gloves and safety glasses. 5a. Contain decontamination water so that it does not spill. 5a. Use an absorbent pad to clean spills, if necessary. 5a. Spray equipment from side angle, not straight on, to avoid backsplash. 5a. See 3b. 5b. See 4a. Review SDS to ensure appropriate precautions are taken and understood.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-007**	DATE 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **General Site Activity**	WORK ACTIVITY (Description) **Driving**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Valerie Sabatasso	Staff Scientist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT: when outside vehicle ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES: when outside vehicle	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION ☒ SAFETY TOE BOOTS: when outside vehicle	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: high visibility vest, when outside vehicle	☒ GLOVES: Leather/ cut-resistant level 2 ☐ OTHER _____

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Motor Vehicle (i.e. car, truck, SUV)

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

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Driving to/leaving Site	**1a. CONTACT:** Severe injury/disability, property damage, monetary loss (insurance premiums, deductibles, loss of license/job) caused by collision with or struck by other vehicles, obstructions, pedestrians, animals, etc. *Common factors that may lead to CONTACT incident, but not limited to: • distracted driving (cell phone, GPS, radio, billboards, “rubber necking”) • lack of situational awareness • unfamiliarity with traffic patterns/road layout • weather conditions (wet/icy roads, hydroplaning, black ice) • weariness • high speeds • obstructed vision (solar glare, debris on windshield, blind spots) • changes in travel pathway (construction, snow banks, non-operational signals, potholes, detours, special events) • improper vehicle maintenance (non-operational signal light, worn tires, cracked windshield, ineffective wipers) • loose or unsecure objects	1a. PLAN AHEAD – review/make yourself familiar with maps and driving directions before beginning the drive to the Site. Do not attempt to drive and review maps/directions at the same time. Pull over and stop your vehicle before looking at maps/directions. 1a. Complete a basic vehicle inspection before driving. Verify Inspection and Registration are current, tires and wipers are in good condition, all lights are functional, all glass/mirrors are undamaged, the horn is functional, roof/hood/trunk are free from accumulated snow and visibility is not impaired due to snow/ice/frost/fog on windows. 1a. Do not hang items in car that can obstruct your view or become projectiles in a collision. 1a. Do not get distracted using touch screen radios or GPS units built into newer models. Keep your eyes on the road and stay alert. 1a. Follow posted speed limits and obey traffic signals and roadway signs. 1a. Always wear your seat belt and shoulder harness when driving. 1a. When driving around large vehicles and trucks, maintain extra space as these vehicles may not be able to see a smaller car too close. 1a. Follow the "Rules of the Road" including: using your turn signals, coming to a complete stop, and allowing vehicles the right of way (yield) when they are when traffic laws require. 1a. Apply the Smith Five Keys® of safe driving • Aim High in Steering® - Expand eye lead time to a minimum of 15 seconds • Get the Big Picture® - Maintain proper a 4 second minimum following distance at all times - Scan mirrors every 5-8 seconds to achieve a circle of awareness - Position your vehicle so you can see relevant/non-relevant objects • Keep Your Eyes Moving® - Try to maintain about 180 degrees of visibility - Avoid blank and fixed stares. Avoid focusing on one object for more than 2 seconds • Leave Yourself an Out® - Avoid traveling in traffic clusters - Surround yourself with space - Anticipate the actions of others

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Driving to/leaving Site (cont'd)	**1a. CONTACT:** Severe injury/disability, property damage, monetary loss (insurance premiums, deductibles, loss of license/job) caused by collision with or struck by other vehicles, obstructions, pedestrians, animals, etc.	• Make Sure They See You® - Maintain eye contact with on-coming vehicles/pedestrians - Use warning devices (e.g., hand signals, high-lights, horns etc.) - Proper timing is essential 1a. Do not perform reconnaissance or inspections while driving. Your vehicle should be parked in a safe location when viewing or surveying the Site and vicinity 1a. Avoid sudden turns and stops. Don't drive recklessly – be in control of vehicle at all times. 1a. In inclement weather, first determine if work can be POSTPONED. Otherwise, plan according to weather conditions including checking forecast along entirety of travel route (especially, for long distances). Reduce speed as road conditions warrant. Travelling with winter car equipment, in the winter, is strongly recommended (i.e., shovel, scraper, brush, blanket, extra clothing, flashlight, bag of sand). If your vehicle has 4-wheel drive, review to operators manual and understand operating procedure prior to engaging 4-wheel drive. If at any point on your drive weather becomes too severe to proceed safely pull over if safe to do so or seek nearest cover (e.g., overpass) 1a. If feeling drowsy or sleepy, do not drive. Pull over in a safe place to rest if you experience any signs of drowsiness. Make sure to get adequate sleep the night before an early drive. 1a. Never operate a vehicle under the influence of alcohol or illegal substances or medications affecting your performance. 1a. Keep your eyes on the road. Do not call or talk on cellular phones. Pull over to a safe location if you must answer or make a call. 1a. When parking, pull-through when possible. If backing is required visually inspect area to ensure it is free from obstructions prior to backing in and relying solely on mirrors; use spotters when available.
2. Entering/Exiting Vehicle.	**2a. CAUGHT:** Personal injury (broken fingers/hand) while entering or exiting vehicles **2b. FALL:** Personal injury (twisted ankle, deep contusion, concussion, broken wrist/arm, etc.) from slip/fall on uneven or unstable or slippery surface while exiting/entering vehicle **2c. CONTACT:** Severe injury/disability, property damage, monetary loss (insurance premiums, deductibles, loss of license/job) caused by collision with or struck by other vehicles, obstructions, pedestrians, animals, etc.	2a. Open and close doors slowly. Never put hands or feet in between door and vehicle to avoid pinch points. 2b. When exiting the vehicle make sure your feet are on firm footing and weight is evenly distributed before exiting/standing. In inclement weather use hands to support yourself, by holding the car door and/or steering wheel, when exiting the vehicle. 2c. Check both directions for traffic before opening door. Do not exit vehicle if traffic does not permit you to exit safely 2c. Check anticipated path of door prior to opening, do not open door into any obstructions (e.g., bollards, high curbing)

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-009**	DATE: 8/6/2018	☐ NEW ☒ REVISED	PAGE 1 of 1

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

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Michael Sarni	Technician	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES: Steel or composite toe	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent long sleeve shirt or long sleeve shirt and reflective safety vest.	☒ GLOVES: Cut-resistant gloves ☐ OTHER:

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Mobile Drum Carrier, safety cones, and caution tape

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

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around heavy equipment (i.e. forklift).

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Preparing for and Inspection of Drum	**1a. FALL:** Tripping/falling due to uneven surface. Loose debris/garbage in work area.	1a. Clear area of loose garbage and debris. Inspect 55-gal drums for proper condition, labeling, check drum ring and bolts for tightness, inspect mobile drum carrier. 1a. Do a Test Lift to get a general sense of the weight of the drum. 1a. Inspect and use established pathways to avoid uneven terrain, weather-related hazards (i.e., debris, puddles, ice, etc.), and other obstructions. 1a. Secure work area and coordinate and communicate the planned work activities with other personnel working in the area. 1a. Delineate work area with 42” safety cones.
	1b. CONTACT/EXPOSURE: Drums could potentially be damaged or contain hazardous material. Mobile drum carrier could potentially be in poor working condition causing malfunctioning during operation.	1b. Prior to inspecting drums don cut-resistant gloves. If drum is not properly labeled, do not open and cease all drum transport activities. Immediately contact project manager and inform him/her of drum situation. 1b. Do not continue drum transport activities until further actions are determined by the project manager. 1b. If the drum is properly labeled, but leaking, improperly sealed or in poor condition, place drum in an over-pack drum. 1b. Inspect mobile drum carrier to ensure its overall integrity. Look for rust marks or potential weak points where the drum carrier could malfunction. Inspect the wheels to ensure that they easily turn and nothing is impeding their movement.
	1c. EXERTION/CAUGHT: Potential pinching/exertion hazards while securing ring/ tightening bolts	1c. Keep back straight and knees slightly bent while securing drum ring/tightening bolt. Wear cut-resistant gloves.
2. Position drum clamp tightly in between drum ribs, securing drum clamp to drum with chain	**2a. CAUGHT:** Pinching fingers between drum clamp and handle/chain.	2a. Attach drum clamp with chain and tighten until snug. Do not place hands between drum clamp and drum as the chain is tightened; wear cut resistant gloves. Keep face away from drum when handling in case of escaping vapors.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

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

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

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

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

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

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

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

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

☒ GLOVES: Cut-resistant or leather
☒ OTHER: Long sleeve Shirt

REQUIRED AND / OR RECOMMENDED EQUIPMENT

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

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

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Check in with Site manager/ property owner.	**1a. CONTACT/EXPOSURE/FALL:** Lack of communication could result in H&S incident.	1a. Inform Site personnel of work scope, timeline and location(s). 1a. Inquire about other activities taking place at the Site. 1a. If applicable, obtain General Work permit for the day.
2. Locate surveying position for instrument and rod and set-up work area	**2a. FALL:** Slip/trip hazards	2a. Inspect area for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.) and obstructions prior to setting up at the survey location. Keep eyes engaged with walking surface while in movement. Remember “Walking is Working.” 2a. Conduct housekeeping and maintain clear paths to walk in and remove debris as required.
	2b. CONTACT: Traffic (surveying locations could potentially be in parking areas and sidewalks)	2b. Be aware of oncoming traffic. Utilize a flagman / spotter for locations in streets or high-traffic areas. 2b. Place 42 inch cones around the work area and delineate work zone with caution tape, snow fencing or safety bars, if necessary. 2b. Wear appropriate PPE including long sleeve high visibility clothing and or reflective safety vest. 2b. Face traffic, maintain eye contact with oncoming vehicles and establish a safe exit route.
	2c. OVEREXERTION: Hazard due to carrying, lifting, and bending while transporting equipment	2c. Use proper body positioning and lifting techniques; keep back straight, lift with legs, keep load close to body, and never reach with a load. 2c. Avoid carrying too much equipment at one time and team-lift equipment that is more than 50 lb.
	2d. CAUGHT/CONTACT: Pinch Points / sharp edges associated with setting up the tripod	2d. Wear cut resistant gloves when handling the tripod and keep fingers away from pinch points located near moving parts of the tripod. Don’t carry tripod by the pointed ends.
	2e. OVEREXERTION: Hazard due to bending awkwardly to look through the autolevel	2e. When practical, set the height of the autolevel optic as to minimize bending at the waist.

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

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JOB SAFETY ANALYSIS Ctrl. No. GEN-013	DATE 1/4/2018	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE: **Gauging and Sampling**	WORK ACTIVITY (Description): **Gauging and Sampling**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Brandon Tufano	Staff Geologist	Brian Hobbs	Senior Health & Safety Manager
		Joe Gentile	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☒ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES: Composite-toe or steel toe boots	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing	☒ GLOVES: Leather, Nitrile and cut resistant ☒ OTHER: Knee pads, Insect Repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

42-inch Safety Cones, Caution Tape, Interface Probe and/or Water Level Meter, 20-lb., Type ABC Fire Extinguisher, Buckets. Tools as needed: Socket Wrench, Screw Driver, Crow Bar, Mallet, and Wire Brush.

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

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Mobilization to monitoring well(s).	**1a. FALL:** Personal injury from slip/trip/fall due to uneven terrain and/or obstructions.	1a. Inspect pathway and plan for most suitable designated pathway prior to mobilization. 1a. Use established pathways, walk and/or drive on stable, secure ground and avoid steep hills or uneven terrain. 1a. If working near open water with an unguarded edge, wear life vest.
	1b. CONTACT: With traffic/third parties.	1b. Identify potential traffic sources and delineate work area with 42-inch traffic safety cones. Position vehicle to protect against oncoming traffic. Use caution tape to provide a more visible delineation of the work area if necessary. 1b. Wear appropriate PPE including high visibility clothing or reflective vest. 1b. Face traffic, maintain eye contact with oncoming vehicles, and establish a safe exit route.
	1c. EXERTION: Muscle strain from lifting equipment	1c. Use proper lifting techniques when handling/moving equipment; bend knees and keep back straight. 4c. Use mechanical assistance or team lifting techniques when equipment is 50 lbs. or heavier. 4c. Make multiple trips to carry equipment.
	1d. EXPOSURE: To biological hazards.	1d. Inspect work area for bees and insects. 1d. Use insect/tick repellent as necessary.
2. Open/close well.	**2a. EXERTION:** Muscle strain.	2a. Use proper lifting techniques; keep back straight, lift with legs and bend knees when reaching to open/close well.
	2b. CAUGHT: Pinch/crush points associated with removing/replacing manholes and working with hand tools.	2b. Wear leather gloves or cut resistant gloves when working with well cover and hand tools. 2b. Use proper tools (ratchet and pry bar for well cover) and inspect before use. 2b. Do not put fingers under well cover.
	2c. CAUGHT: Pinch points associated with placing J-plug back onto PVC pipe.	2c. See 2b. 2c. Keep fingers out of line-of-fire when securing cap.
	2d. EXPOSURE: To potential hazardous vapors.	2d. No open flames/heat sources. 2d. To minimize exposure to vapors, allow well to vent after opening it and before sampling activities begin. 2d. Stand up-wind, if possible, to avoid inhaling vapors.
3. Gauge well.	**3a. CONTACT:** With contamination (e.g. contaminated groundwater).	3a. Wear chemical-resistant disposable gloves (over cut-resistant gloves) and safety glasses when gauging well. 3a. Insert and remove probe slowly to avoid splashing. 3a. Use an absorbent pad to clean probe.
	3b. CONTACT: With traffic.	3b. See 1b.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
4. Purge and sample well	**4a. EXPOSURE/CONTACT:** To contamination (e.g., SPH, contaminated groundwater, vapors) and/or sample preservatives.	4a. Open and fill sample jars slowly to avoid splashing and contact with preservatives. 4a. Wear cut-resistant gloves and chemical-resistant disposable gloves when sampling. 4a. Fill sample containers over purge container to avoid spilling water onto the ground. 4a. Use an absorbent pad to clean spills. 4a. When using a bailer to purge a well, pull the bailer slowly from the well to avoid splash hazards. 4a. When sampling or purging the water using a bailer, pour out water slowly to reduce the potential for splash hazards with groundwater. 4a. When using a tubing valve always remove the valve slowly after sample collection to release any pressure and avoid pressurized splash hazards. 4a. When collecting a groundwater sample always point sampling apparatus (tubing, bailer, etc.) away from face and body.
	4b. CONTACT: Personal injury from cuts, abrasions, or punctures by glassware or sharp objects.	4b. To avoid spills or breakage, place sample ware on even surface. 4b. Do not over tighten caps on glass sample ware. 4b. Wear chemical-resistant nitrile disposable gloves over cut-resistant (i.e., Kevlar) gloves when sampling and handling glassware (i.e., VOA vials) or when using cutting tools.
	4c. EXERTION: Muscle strain while carrying equipment.	4c. Use proper lifting techniques when handling/moving equipment, bend knees and keep back straight. 4c. Use mechanical assistance or team lifting techniques when equipment is 50 lbs. or heavier. 4c. Make multiple trips to carry equipment.
	4d. CONTACT: With traffic.	4d. See 1b.
	4e. CONTACT: Pinch points with groundwater pump components (i.e., wheel, line, clamps).	4e. Wear leather gloves when working with groundwater pumps. 4e. Never place hands on or near pinch points such as the wheel, clamps or other moving parts during pump operations. 4e. Use the correct mechanisms, such as a pump reel, to lower pump into well. 4e. Never attempt to manually stop any moving part of equipment including hose reels and/or tubing.
	4f. EXERTION: Muscle strain from repetitive motion of bailing and sampling a well.	4f. See 4c. 4f. Include a stretch break when repetitive motions are part of the task.
5. Management of purge water.	**5a. EXPOSURE/CONTACT:** To contamination (e.g., SPH, contaminated groundwater, vapors).	5a. Do not overfill container and pour liquids slowly so that they do not splash. 5a. Properly dispose of used materials/PPE in appropriate container in designated storage area.
	5b. EXERTION: Muscle strain from lifting/carrying and moving containers.	5b. Use proper lifting techniques when lifting / carrying or moving container(s) (see 4c.). 5b. Do not overfill container(s).
6. Decontaminate equipment.	**6a. EXPOSURE/CONTACT:** To contamination (e.g., SPH, contaminated groundwater, vapors).	6a. Work on the upwind side, where possible, of decon area. 6a. Wear chemical-resistant disposable gloves and safety glasses. 6a. Use an absorbent pad to clean spills.
	6b. CAUGHT: Pinch points associated with handling hand tools	6b. See 2b. 6b. Inspect hand tools for sharp edges before decontaminating.

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JOB SAFETY ANALYSIS **Ctrl. No. GEN-014**	DATE: 8/6/2018	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **Generic**	WORK TYPE: **Drilling**	WORK ACTIVITY (Description): **Hollow Stem Auger Soil Borings / Well Installation**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Douglas Ferraiolo	Staff Geologist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☒ GOGGLES: Spoggles required if winds exceed 15 mph. ☐ FACE SHIELD ☒ HEARING PROTECTION: (as needed). ☒ SAFETY SHOES: Steel or Composite Toe.	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent long-sleeve shirt or long-sleeve shirt and reflective safety vest.	☒ GLOVES: Leather, Cut-Resistant, and Nitrile. ☒ OTHER: Insect Repellant, Sunscreen (as needed).

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Truck-Mounted Drilling Rig or Track Rig, Saw, Hand Tools, Photoionization Detector, Multi-Gas Meter (or equivalent), Interface Probe, 20 lb. Type ABC Fire Extinguisher, 42” Cones & Flags, “Work Area” Signs.

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

EXCLUSION ZONE (EZ) – All non-essential personnel shall maintain a **10 foot** exclusion zone while drill rig is engaged.

“SHOW ME YOUR HANDS”
Driller and helper should show that hands are clear from controls and moving parts

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Mobilization / demobilization and establish a work area.	**1a. See Mobilization/ Demobilization JSA GEN-015.**	1a. See Mobilization / Demobilization JSA GEN-015.
2. Raising tower / derrick of drilling rig.	**2a. CONTACT:** Overhead hazards.	2a. Prior to raising the tower / derrick, the area above the drilling rig will be inspected for overhead hazards (wires, tree limbs, piping or other structures) that may be contacted by the rig’s tower or drilling rods. 2a. The tower / derrick must not be raised beneath overhead power lines unless approved by the Roux PM. 2a. Maintain a minimum of 10’ from all overhead structures. 2a. Do not move the rig while the tower / derrick is raised.
	2b. CONTACT: Amputation / crush points when raising the rig and instability of rig.	2b. Inspect the equipment prior to use and avoid any potential amputation points. 2b. Lower outriggers to ensure stability prior to raising rig tower derrick. Keep feet and body out of the line of fire when lowering out-riggers. 2b. Inspect the set-up location for uneven terrain. Level or avoid area if needed. 2b. If the rig needs to be mounted, be sure to use three points of contact.
3. Advancement of augers for soil boring installation.	**3a. CONTACT:** Equipment imbalance during advancement of drill equipment.	3a. Drillers will advance the borehole with caution to avoid causing the rig to become imbalanced and / or tip. 3a. The blocking and leveling devices used to secure the rig will be inspected by drillers and Roux personnel regularly to see if shifting has occurred. 3a. Drillers will maintain the “Purple Zone” policy surrounding augers to ensure no personnel come into contact with augers while in use. Workers will spray paint a 3’ semi-circle surrounding the augers to visually show that no personnel should enter the “Purple Zone” while drilling activities are being conducted. 3a. In addition, personnel and equipment that are non-essential to the advancement of the borehole will be positioned away from the rig at a distance that is at least as far as the boom is high (minimum exclusion zone of 20 feet).
	3b. CONTACT: Flying / spraying debris.	3b. Wear all required PPE (especially hand, eye, and ear protection). 3b. Maintain minimum 20’ EZ distance when rig is in operation to avoid potential line of fire hazards from flying materials or debris.
	3c. CAUGHT: Limb/extremity amputation, abrasion, and crushing.	3c. Inspect the equipment prior to use for potential pinch points. 3c. Test all emergency shutdown devices prior to drilling. 3c. Inspect drill head for worn surface or missing teeth; replace if damaged or blunt. 3c. Inspect augers, do not use if auger flight is damaged or bent.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Advancement of augers for soil boring installation (Continued).		3c. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body. 3c. All non-essential personnel should stay away from the immediate work area; position body out of the line-of-fire of equipment particularly when installing auger flights and steel override casings. 3c. Drillers and helpers will understand and use the "Show Me Your Hands" Policy. 3c. Spinning augers should have an exclusion zone of 20 feet when in operation.
	3d. FALL: Slip/trip/fall hazards.	3d. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 3d. Do not climb over stored materials/equipment; walk around. Practice good housekeeping. 3d. Use established pathways and walk on stable, secure ground. 3d. Use three points of contact when mounting or dismounting the rig. 3d. Remove soil cuttings to avoid a tripping hazard from developing near augers.
	3e. EXPOSURE: Inhalation of contamination / vapors.	3e. Air monitoring using a calibrated photoionization detector (PID) to periodically monitor the breathing zone of the work area. 3e. The Action Level for breathing zone air is five parts per million (sustained) as detected by the PID. 3e. If a reading of >5ppm is recorded, the Roux field personnel must temporarily cease work, instruct all Site personnel to step away from the area of elevated readings and inform the Roux PM of the condition. The Roux PM will then recommend additional appropriate precautions in accordance with the site specific health and safety plan.
	3f. EXPOSURE: Noise and dust.	3f. Wet borehole area with sprayer to minimize dust. Stand upwind and keep body positioned away from rig. 3f. Wear hearing protection while drill rig is operating and / or the noise levels exceed 85 dBA.
	3g. EXERTION: Installing well casings and lifting augers.	3g. Keep back straight and bend at the knees. 3g. Utilize team lifting for objects over 50lbs. 3g. Use mechanical lifting device for odd shaped objects.
4. Installation of well materials.	**4a. CONTACT:** Installing well materials while also pulling up augers.	4a. Potential contact with augers during installation of well materials. 4a. Keep distance from augers and do not place any materials while augers are in motion.
	4b. CAUGHT: Possible pinch or crush hazard assembling PVC and sending down the borehole.	4b. Keep all body parts out of potential pinch points while placing PVC together and sending down borehole.
	4c. FALL: Slip/trip/fall hazards with hand tools and materials.	4c. See 3d.
	4d. EXPOSURE: Potential contamination, harmful vapors, dust, and / or noise.	4d. See 3e and 3f. 4d. Stand upwind to avoid exposure to dust generated from packing materials.
	4e. EXERTION: Lifting heavy bags of materials to backfill borehole.	4e. Ergonomic hazard lifting bags of sand and bentonite while packing the well.
5. Cleaning the auger flights	**5a. CONTACT:** Cuts/scrapes or puncture wound from contacting auger.	5a. Follow "Show Me Your Hands" Procedure and make sure auger is out of gear before contacting auger with tool or hand. 5a. Pull cleaning tool across your body with handle away from body; do not push toward the auger. 5a. Do not clean more than ¾ turn around the auger at a time. 5a. Wear cut resistant and leather gloves. 5a. Always use two hands to operate cleaning tool. 5a. Inspect tool before use and remove from service if handle or metal are cracked/fatigued. 5a. Stand out of the line of fire.
6. Decontaminate equipment.	**6a. EXPOSURE / CONTACT:** To contamination (e.g., contaminated groundwater, vapors).	6a. Wear chemical-resistant disposable gloves and safety glasses. 6a. Contain decontamination water so that it does not spill. 6a. Use an absorbent pad to clean spills, if necessary.
	6b. EXPOSURE: To chemicals in cleaning solution (including ammonia).	6b. See 3e. Wear all appropriate PPE and stand upwind of any exposed cleaning solutions.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

JOB SAFETY ANALYSIS	**Ctrl. No. GEN-015**	DATE: 8/6/2018	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Mobilization/Demobilization**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Rebecca Lowy	Staff Assistant Geologist	Brian Hobbs	Corporate Health & Safety Manager
Tally Sodre	OHSM		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION (as needed) ☒ SAFETY SHOES: Steel Toe or composite toe	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest of high-visibility clothing; long sleeve shirt; long pants	☒ GLOVES: Leather, nitrile, and cut resistant (as needed) ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: Varies

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

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around equipment in use..

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Mobilize/demobilize and establish work area	**1a. FALL:** Slip/trips/falls from obstructions, uneven terrain, weather conditions, heavy loads, and/or poor housekeeping.	1a. Use 3 points-of-contact/ensure secure footing when entering and exiting vehicle. 1a. Inspect walking path for uneven terrain, steep hills, obstructions, and/or weather-related hazards (i.e., ice, snow, and puddles) prior to mobilizing equipment. Use established pathways. Walk on stable/secure ground. 1a. Do not climb over stored materials/equipment; walk around. Practice good housekeeping; organize and store equipment neatly in one area at its lowest potential energy. 1a. Wear boots with adequate treads. 1a. Delineate unsafe areas with 42” cones, caution tape and/or flagging.
	1b. CONTACT: Personal injury and/or property damage caused by being struck by Site traffic or equipment used in Site activities.	1b. Observe and maintain the posted speed limits. 1b. When first arriving onsite, park vehicles in designated parking space and/or out of the way locations. Use parking brake on all vehicles and tire chocks on work trucks and trailers. 1b. Check in with Site Manager/Supervisor to ensure coordination with other Site activities and to discuss any special hazards. Ensure that short-service employees (SSE) are identified. 1b. Identify potential traffic sources. 1b. Wear PPE including high visibility clothing or reflective vest. 1b. Use a spotter while moving work vehicles; plan ahead to avoid backing whenever possible. 1b. Maintain a minimum 10’ exclusion zone when vehicles are in motion. When backing up truck rig with an attached trailer use a second spotter if there is tight clearance simultaneously on multiple sides of the equipment or if turning angles limit driver-to-spotter visibility. 1b. Delineate work area with 42” cones, flags, caution tape, and/or other barriers. 1b. Position “Work Area” signs at Site entrances, if possible, or at either side of work area.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
		1b. Position largest vehicle to protect against oncoming traffic. 1b. Face traffic, maintain eye contact with oncoming vehicles, use a spotter, and establish a safe exit route. 1b. Observe potential overhead and ground surface features that may interfere with moving equipment. Clear the path of physical hazards prior to initiating mobilization.
	1c. CAUGHT: Personal injury from pinch points and being in line-of-fire of vehicle and/or equipment.	1c. Make sure driver has engaged parking brake and placed wheel chocks in a position to prevent movement. Be sure that vehicle is parked in front/down gradient (positioned to best block oncoming traffic) of work area. 1c. Wear leather gloves when handling any tools or equipment. Wear cut-resistant gloves (Kevlar or similar) when handling sharp objects/cutting tools/glass. 1c. Keep body parts away from line-of-fire of equipment. 1c. Always carry tools by the handles and/or designated carrier. Ensure sharp-edged tools are sheathed/secure. 1c. Remove any loose jewelry. Avoid wearing loose clothing and/or ensure loose clothing is secure. 1c. Secure all items on the equipment, tighten up any items or features that have potential to shift or break during mobilization.
	1d. OVEREXERTION: Muscle strains while lifting/carrying equipment.	1d. Use body positioning and lifting techniques that avoid muscle strain; keep back straight, lift with legs, turn with whole body, keep load close to body, and never reach with a load. 1d. Ensure that loads are balanced. Use assistance (mechanical or additional person) to carry equipment that is either unwieldy or over 50 lbs.
	1e. EXPOSURE: Personal injury from exposure to biological and environmental hazards.	1e. Inspect area to avoid contact with biological hazards (i.e. poisonous plants, stinging insects, ticks, etc.). 1e. Wear long sleeved clothes treated with Permethrin, apply insect repellant containing DEET to exposed skin, and inspect clothes and skin for ticks during and after work. 1e. Apply sunscreen (SPF 15+) if exposure to sun for 30 minutes or more is expected.
	1f. EXPOSURE: Weather related injuries.	1f. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, nausea, rapid and shallow breathing). Take breaks in cool places and hydrate as needed. 1f. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks in warm areas as needed. 1f. Wear clothing appropriate for weather and temperature conditions (e.g., rain jackets, snow pants, multiple layers). 1f. If lightning is observed, wait 30 minutes in a sheltered location (car is acceptable) before resuming work.
	1g. EXPOSURE: Personal injury from noise hazards.	1g. Wear hearing protection if sound levels exceed 85 dBA (if you must raise your voice for normal conversation).

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

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

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

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

- ☐ LIFE VEST
- ☒ HARD HAT
- ☐ LIFELINE / BODY HARNESS
- ☒ SAFETY GLASSES
- ☐ GOGGLES
- ☐ FACE SHIELD
- ☒ HEARING PROTECTION (as needed)
- ☒ SAFETY SHOES: Composite-toe or steel toe boots
- ☐ AIR PURIFYING RESPIRATOR
- ☐ SUPPLIED RESPIRATOR
- ☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing
- ☒ GLOVES: Leather or cut-resistant and Nitrile
- ☒ OTHER: Insect repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

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

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

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

"SHOW ME YOUR HANDS"
Driller and helper should show that hands are clear from controls and moving parts

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

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Develop well (mechanical surging).	**3a. CAUGHT:** Cut hazards and finger pinch points.	3a See 2b. 3a. Use required PPE including leather/cut-resistant gloves when handling development equipment. Identify finger/hand pinch points. Keep hands away from active surge equipment. 3a. All non-essential personnel should **maintain an exclusion zone greater than the swing/tip radius of equipment.**
	3b. CONTACT/EXPOSURE: Contamination (e.g., SPH, contaminated groundwater, vapors).	3b. See 2c. 3b. Wear Nitrile gloves and safety glasses. Insert and remove surge block/plunger and line/cable slowly to avoid splashing at the surface. 3b. Use an absorbent pad to clean any spills.
	3c. EXERTION: Muscle strain from lifting equipment.	3c. See 2a. 3c. Use mechanical device to insert and remove surge block/plunger if greater than 50lb.
	3d. CONTACT: Injury while handling wench line/cable, or with active surging equipment.	3d. If using a drill rig, inspect all wench lines/cables for any kinks or if frayed prior to use. Replace any damaged lines/cables. Review **Drill Rig checklist prior to development activities**. 3d. See 3a.
4. Purging well (pumping water to holding tanks/drums/buckets).	**4a. CAUGHT:** Pinch points associated with connecting hose to tank. Pinch points associated with handling pump and hoses.	4a. See 3a. 4a. Ensure that fingers are not placed near coupling when attaching and securing hose(s). Do not place fingers under pump/hoses. Wear leather or cut-resistant gloves when handling pump/hose(s). 4a. Keep hands clear from any line of fire.
	4b. FALL: Using side mounted ladder when attaching hose to tank. Slip, trip, fall from lines/hoses	4b. Inspect ladder steps to make sure steps are not bent/damaged and free of debris/fluid. 4b. Use three points of contact always when using ladder. 4b. Use hoist or other mechanical means to secure and move hose. 4b. Utilize anti-whip cords on all compressed hoses. Keep hoses and lines coiled and organized out of designated walking paths around the work zone.
	4c. CONTACT: Contamination (e.g., SPH, contaminated groundwater).	4c. Secure water hose. 4c. Do not overfill tanks, and purge/transfer liquids in such a manner that they do not splash. (See 3b). 4c. Dispose of used materials/PPE in the designated impacted PPE container.
	4d. EXERTION: Muscle strain from lifting/carrying equipment.	4d. See 2a.
	4e. FALL: Spilled purge water.	4e. Clean up any spills using absorbent pads or spill kits.
5. Decontaminate equipment	**5a. CONTACT/EXPOSURE:** Contamination (e.g., SPH, contaminated groundwater, vapors).	5a. See 3b.
	5b. EXPOSURE/CONTACT: Chemicals in cleaning solution	5b. Decontaminate equipment in well-ventilated area. Wear nitrile gloves to avoid skin contact with cleaning solutions.

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

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Site Recon**	WORK ACTIVITY (Description) **Site Walk and Inspection**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Sara Barrientos	Staff Geologist	Brian Hobbs	Corporate Health and Safety Manager
		Joe Duminuco	Vice President

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☐ FACE SHIELD ☒ HEARING PROTECTION: ear plugs as necessary ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: High-visibility vest or high-vis outerwear	☒ GLOVES: Leather/cut-resistant/chemical resistant ☒ OTHER: Tyvek and rubber boots as necessary, dust mask as necessary

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: Site map, emergency contact list, documentation of urgent care/hospital routes and / or guide familiar with Site, operating cell phone or walkie-talkie if Site allows.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

SITE SECURITY: Prior to site inspection verify appropriate method to address Site Security concerns as it relates to potential criminal activity, homeless population, and/or isolation concerns. Work with the Project Principal and/or Project Manager to address appropriately.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Check in with Site contact.	**1a. CONTACT/EXPOSURE/FALL:** Personal injury caused by lack of site specific hazards.	1a. Inquire about hazards and other activities taking place at the Site. 1a. Inform Site contact of work scope, timeline and location(s). 1a. Discuss emergency evacuation procedures and muster points with Site contact.
2. Traversing the Site	**2a. CONTACT:** Property damage and personal injury caused by obstructions/vehicles or unauthorized personnel at remote Sites.	2a. All equipment must be stowed and secured prior to moving. 2a. Maintain speed limit as posted on-site. 2a. When possible drive on established roadways. 2a. Yield to all pedestrians. 2a. Use pull-through spots or back into parking spots. 2a. Don high visibility clothing/safety vest. If working at remote Site, add orange accessories during hunting season.
	2b. FALL: Uneven terrain and weather conditions. Overgrown shrubs and vines. Equipment in the work zone.	2b. Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 2b. When possible, use established pathways and walk on stable, secure ground. 2b. Communicate traversing hazards with others.
	2c. OVEREXERTION: Muscle strain while carrying equipment.	2c. When carrying equipment to/from work area, use proper lifting techniques; keep back straight, lift with legs, keep load close to body, never reach with a load. Ensure that loads are balanced to reduce the potential for muscle strain. Use mechanical assistance or make multiple trips to carry equipment.
	2d. EXPOSURE: Biological hazards – ticks; bees/wasps; poison ivy; insects; (Ticks are most active any time the temperature is above freezing, typically from March to November.)	2d. Inspect area to avoid contact with biological hazards. 2d. Ticks: • Treat outer clothing including pants, shirts, socks, boots and hats the evening before with Permethrin (allowing at least two hours before use). • Apply DEET to exposed skin before travelling to the Site and reapply after two hours. • Check for ticks during and after work. 2d. Bees: • Use bee spray as appropriate to deter/eliminate bees. • Protect exposed skin with insect repellent.

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	2e. EXPOSURE: Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	2d. Poison Ivy: • Identify areas of poison ivy and spray with weed killer. Don Tyvek and rubber boots while traversing poison ivy areas. • If skin contacts poison ivy, wash skin thoroughly with soap and water. 2e. Wear sunscreen with SPF 15 or greater on exposed skin whenever 30 minutes or more of sun exposure is expected. 2e. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 2e. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 2e. Wear appropriate rain gear as needed. 2e. Take frequent breaks if tired, wet, or cold/hot. Drink water. 2e. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
3. Walking near heavy equipment and machinery.	**3a. CONTACT:** Personal injury from Site and roadway traffic. Personal injury from flying debris **3b. OVEREXERTION:** Personal injury from lifting/moving/rotating equipment. **3c. EXPOSURE:** Hearing damage from noise generating equipment/processes. Inhalation/exposure to hazardous vapors and or dust. **3d. EXPOSURE:** Working in a remote area.	3a. See 2a. 3a. Maintain an exclusion zone of at least 10'-25' feet from all engaged equipment. 3a. Keep body parts out of the line of fire of pinch points. 3a. Wear appropriate PPE always. 3b. See 2c. 3c. Wear hearing protection if >85 dBA. (i.e. noise levels which require you to raise your voice to communicate) 3c. Always wear leather gloves when handling any tools or equipment. 3c. Always wear appropriate PPE based off chemicals present. 3d. Use the "buddy system" whenever possible. If working alone, contact PM upon arrival/departure, as well as during work activities prior to commencing work if applicable. 3d. Always carry a communication (i.e., cell phone, walkie-talkie) or directional (i.e., map, compass, etc.) device when traversing remote areas.
4. Working in adverse weather conditions.	**4a. EXPOSURE:** Heat Stress & Cold Stress. Personal injury from working in inclement weather conditions.	4a. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). Take breaks as needed. 4a. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). Take breaks as needed. 4a. Wear appropriate rain gear as needed. 4a. Take frequent breaks if tired, wet, or cold/hot. Drink water. 4a. If lightning is observed, wait 30 minutes after last thunder boom/lightning bolt in a sheltered location (car acceptable) before starting work again.
5. Departing Site.	**5a. EXPOSURE:** Exposure to unnecessary hazards should personnel believe Roux is on-Site during an emergency and conduct a search.	5a. Sign out or notify Site contact and Roux Project Manager of your departure.

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JOB SAFETYANALYSIS **Ctrl. No. GEN-020**	DATE: 8/6/2018	☐NEW ☒REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **GENERIC**	WORK TYPE: **Gauging & Sampling**	WORK ACTIVITY (Description): **Soil Sampling**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
MaryBeth Lyons	Project Scientist	Brian Hobbs	Corporate Health and Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES ☒ FLAME RESISTANT CLOTHING (as needed)	☐ GOGGLES ☐ FACE SHIELD: ☒ HEARING PROTECTION: (as needed) ☒ SAFETY SHOES: Composite-toe or steel toe boots	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing	☒ GLOVES: Leather, Nitrile and cut resistant ☒ OTHER: Insect repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Recommended Equipment: 42” traffic cones, caution tape, trowel

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

EXCLUSION ZONE (EZ): A 10-foot exclusion zone will be maintained around moving equipment, if present.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Secure location	**1a. CONTACT:** Personnel and vehicular traffic may enter the work area.	1a. If in an area with foot or vehicle traffic, delineate the work area with 42” traffic cones and/or caution tape to prevent exposure to traffic and inform others of work activity. 1a. Wear reflective vest and/or high visibility clothing. 1a. Face the direction of any vehicular traffic. Position vehicle to protect worker from traffic. 1a. Communicate work activity with adjacent work areas.
	1b. FALL: Tripping/falling due to uneven terrain or entry/exit from excavations.	1b. Inspect pathways and work area for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions. 1b. Use established pathways and walk on stable, secure ground. 1b. Stage equipment and tools in a convenient, stable, and orderly manner. Store equipment at lowest potential energy. 1b. Roux employees should stay 5 feet from in-progress excavations and trenches. Should entry to an excavation be required (when stabilization is complete), ladders must be employed for steep embankments, excavations, pits, and trenches.
	1c. EXPOSURE: Exposure to sun and excessive heat, possibly causing sunburn, heat exhaustion or heat stroke. Exposure to cold temperatures possibly causing cold stress. Skin burn as a result of fire, if applicable. Exposure to explosive vapors due to tank farm operations. Exposure to airborne dust due to high wind speeds. Biological hazards - ticks, bees/wasps, poison ivy, thorns, insects, etc.	1c. Wear sunscreen with an SPF 15 or greater whenever 30 minutes or more of exposure is expected. 1c. Use a tent to shade the work area from direct sunlight particularly when warm temperatures are expected. 1c. Be aware of the location of all Site personnel. 1c. Watch for heat stress symptoms (muscle cramping, exhaustion, dizziness, rapid and shallow breathing). 1c. Watch for cold stress symptoms (severe shivering, slowing of body movement, weakness, stumbling or inability to walk, collapse). 1c. Take breaks for rest and water as necessary. Move to an area that is well shaded or a climate controlled area (i.e., car, site trailer, etc.). 1c. No open flames/heat sources. 1c. Flame retardant clothing must be worn when specified by Site policy. 1c. Cell phones should be disabled when specified by Site policy. 1c. Pre-treat field clothing with Permethrin prior to site visit to kill ticks and insects. 1c. Wear long sleeved shirts and tuck in (or tape) pant legs into socks or boots to prevent ticks from reaching skin. 1c. Spray insect repellant containing DEET on exposed skin when working in overgrown areas of the Site. 1c. Inspect area to avoid contact with biological hazards. 1c. Wear cut-resistant gloves when handling branches, shrubs, etc. that may lie within the walking path. 1c. Wear spoggles if the average wind speeds are above 15 mph. 1c. Personnel shall examine themselves and co-worker’s outer clothing for ticks periodically when onsite. 1c. If skin comes in contact with poison ivy, wash skin thoroughly with soap and water. If rash persists after washing, immediately notify your supervisor, the OM and OHSM for possible consultation with a physician at an approved Occupational Health Clinic.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
2. Collect Soil Sample	**2a.** **CONTACT:** Personal injury from pinch points, cuts, and abrasions from sampling equipment tools, and material within soil sample. Personal injury from contact with moving equipment while sampling. Personal injury from contact with glass sample jars.	2a. Wear cut-resistant (i.e., Kevlar) gloves under chemical-resistant (nitrile) disposable gloves when handling soil samples and sampling jars. 2a. Where possible, use trowel or equivalent tool to avoid contact with soil. 2a. If sampling from bucket of heavy equipment, ensure all equipment is off and operator utilizes the “show me your hands” policy. 2a. See 1a.
	2b. **EXPOSURE:** Exposure to contamination (impacted soil) and/or lab preservatives.	2b. Wear chemical-resistant (nitrile) disposable gloves over cut resistant gloves to protect hands when handling samples; use containment material or plastic sheeting to protect surrounding areas. 2b. Wear safety glasses to protect eyes from dust or air-borne contaminants that may results from disturbing the soil. 2b. Where possible, remain upgradient from sample location if collecting soil sample from stockpile, drill rig, etc. to avoid breathing contaminant vapors, if they are present. 2b. When collecting soil sample from hand auger, put large zip lock bag over entire auger to prevent spillage of soil on to the ground. 2b. Open sample jars slowly and fill carefully to avoid contact with preservatives.
	2c. **EXERTION:** Exertion due to repetitive motion and ergonomics.	2c. Utilize a table or raised surface for soil sampling if multiple soil samples are going to be taken to minimize repetitive bending motion.
3. Decontaminate equipment	**3a.** **EXPOSURE/CONTACT:** Contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated vapors and/or soil).	3a. Wear chemical-resistant (nitrile) disposable gloves and safety glasses. 3a. Use an absorbent pad to clean spills. 3a. Properly dispose of used materials/PPE in provided drums in designated drum storage area. 3a. Remain upwind of sample and avoid breathing contaminant vapors, if they are present.
	3b. **EXPOSURE:** Chemicals in cleaning solution including ammonia.	3b. Wear chemical-resistant (nitrile) disposable gloves and safety glasses. 3b. Work on the upwind side of decontamination area. 3b. Use an absorbent pad to clean spills. 3b. Properly dispose of used materials/PPE in provided drums in designated drum storage area. Ensure that all drums are properly labeled and secured.

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JOB SAFETY ANALYSIS **Ctrl. No. GEN-021**	DATE: 8/6/2018	☐ NEW ☒ REVISED	PAGE 1 of 2

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

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Jeff Wills	Project Hydrogeologist	Brian Hobbs	Corporate Health and Safety Manager
Julie Moriarity	Project Scientist		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

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

REQUIRED AND / OR RECOMMENDED EQUIPMENT

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

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

EXCLUSION ZONE (EZ): A 5-foot exclusion zone will be maintained for non-essential personnel.

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

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Screen vapor point with PID.	**3a. FALL:** Potential tripping hazards associated with equipment. **3b. EXPOSURE:** Inhalation of soil vapor	3a. Place equipment in one area close to the sampling location. 3b. Identify area where equipment is to be stored within the work area (away from main walking path). 3a. Don't leave equipment on the ground. Return equipment to storage area between uses. 3b. Replace brass caps immediately upon completion to avoid soil vapors migrating to the surface through sample tubing. 3b. Stand upwind of sample point during screening activities.
4. Remove / replace brass caps at the end of the sam`ple tubing.	**4a. CONTACT:** Pinch points associated with hand tools and brass caps. **4b. EXPOSURE:** Potential pathway for vapors to migrate to land surface.	4a. Use wrench to remove and replace brass caps. 4a. Wear cut-resistant gloves to protect against pinch points and scrapes. 4b. See 3b. 4b. Stand up wind of sample point location.
5. Set up soil vapor sampling equipment and calibration of meters.	**5a. FALL:** Potential tripping hazards associated with equipment and tubing.5b. **5b. CONTACT:** Pinch points associated with handling equipment. **5c. EXPOSURE:** Inhalation of calibration gas and helium.	5a. See 3a. 5a. Keep tubing slack to a minimum and locate the summa canister as close to the sampling location as possible. 5a. Avoid stepping over equipment and tubing. 5b. Do not place fingers/hands under sampling equipment. 5b. Make multiple trips when unloading equipment in work area. 5b. Wear cut-resistant gloves to protect against pinch points while handling sampling equipment. 5c. Review SDS for each type of calibration gas used before calibrating. 5c. Calibrate meters in a well-ventilated area and keep air flow regulator away from face. 5c. Close valve on canisters after use to avoid inhalation of excess helium or calibration gas. 5c. Stand up wind of bucket during helium tracer gas test.
6. Cleaning Work Area.	**6a. FALL:** Potential tripping hazards associated with equipment and tubing. **6b. CONTACT:** Storing and transport of equipment in car.	6a. See 3a. 6a. See 3b. 6b. Ensure that equipment is placed securely in the vehicle. Do not stack equipment on top of each other. Secure equipment so that it will not slide while being transported. 6b. Wear cut-resistant gloves while handling/loading equipment.

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JOB SAFETY ANALYSIS **Ctrl. No. GEN-022**	DATE 8/6/2018	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY: **General**	WORK TYPE: **Drilling**	WORK ACTIVITY (Description): **Rotosonic Soil Borings / Well Installation**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
William Poupis	Vice President ADT	Brian Hobbs	Corporate Health & Safety Manager
Amy Hoffmann	Project Geologist		

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST
☒ HARD HAT
☐ LIFELINE / BODY HARNESS
☒ SAFETY GLASSES
☐ GOGGLES
☐ FACE SHIELD
☒ HEARING PROTECTION: (as needed)
☒ SAFETY SHOES steel or composite toe
☐ AIR PURIFYING RESPIRATOR
☐ SUPPLIED RESPIRATOR
☒ PPE CLOTHING: fluorescent long sleeve shirt or long sleeve shirt and reflective safety vest.
☒ GLOVES: Leather, Nitrile and cut resistant
☒ OTHER: Insect Repellant, sunscreen (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Truck-Mounted Sonic Drilling Rig or Mini Sonic Rig, Hand Tools, Photoionization Detector, Multi-Gas Meter (or equivalent), Interface Probe, 20 lb. Type ABC Fire Extinguisher, 42” Cones & Flags, “Work Area” Signs, Water

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

EXCLUSION ZONE (EZ): A minimum 10’ exclusion zone will be maintained around equipment.

“SHOW ME YOUR HANDS”
Driller and helper should show that hands are clear from controls and moving parts

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Mobilization of drilling rig (ensure the Subsurface Clearance Protocol and Drill Rig Checklist are completed). **See also Mobilization/Demobilization JSA.**	**1a. CONTACT/CRUSH:** Equipment/property damage during movement. Crush point between moving rig and other objects.	1a. The drill rig's tower/derrick will be lowered and secured prior to mobilization. 1a. A spotter should be utilized while moving the drill rig or backing operations. If personnel move into the path of the drill rig, the drill rig will be stopped until the path is again clear. 1a. Set-up the work area and position equipment in a manner that eliminates or reduces the need for backing of support trucks and trailers. 1a. When backing up truck rig with an attached trailer use a second spotter if there is tight clearance simultaneously on multiple sides of the equipment or if turning angles limit driver/spotter visibility. 1a. Inspect the driving path for uneven terrain. Level or avoid if needed. 1a. Drill rig should have a **minimum exclusion zone of 10 feet** for non-essential personnel (i.e., geologist) when the rig is moving/in operation.
	1b. FALL: Slip/trip/fall hazards.	1b Inspect walking path for uneven terrain, weather-related hazards (i.e., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 1b. Do not climb over stored materials/equipment; walk around. Practice good housekeeping. 1b. Use established pathways and walk on stable, secure ground.
2. Raising tower/derrick of drill rig.	**2a. CONTACT**: Overhead hazards.	2a. Prior to raising the tower/derrick, the area above the drilling rig will be inspected for overhead utilities, tree limbs, piping, or other structures, that could come in contact with the rig's tower and/or drilling rods or tools. 2a. Site requirements for raising a tower/derrick around overhead utilities must be reviewed prior to drilling. Maintain **a minimum distance of 10 feet** from overhead structures. 2a. The tower/derrick must not be raised beneath overhead power lines unless approved by both the Roux and Project PMs.
	2b. CONTACT: Amputation points when raising the rig and instability of rig.	2b. Inspect the equipment prior to use and avoid amputation points when engaging tower/derrick. 2b. Lower outriggers to ensure stability prior to raising rig tower/derrick. 2b. If the rig needs to be mounted, be sure to use three points of contact.

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Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Advancement of soil boring and well installation. **See also Soil Sampling JSA.**	**3a. CONTACT**: Flying debris.	3a. Be aware of and avoid potential lines of fire and wear required PPE such as eye, ear, and hand protection.
	3b. EXPOSURE: Noise and dust.	3b. Wet borehole area with sprayer to minimize dust. 3b. Stand upwind and keep body away from rig. 3b. Dust mask should be worn if there is visible dust in the breathing zone. 3b. Wear hearing protection when the drill rig is in operation.
	3c. CAUGHT: Limb/extremity amputation points; abrasion/crushing.	3c. Always wear leather gloves when making connections and using hand tools; wear cut-resistant (i.e., Kevlar) gloves when handling cutting tools. 3c. Inspect the equipment prior to use for potential amputation points. Keep hands away from being between connections and use of tools is preferable compared to fingers and hands. 3c. Inspect drill head for worn surface or missing teeth; replace if damaged or blunt. 3c. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body. 3c. All non-essential personnel should remain outside the heavy equipment exclusion zone that is at least as far as the boom is high (**minimum exclusion zone of 10 feet**). 3c. Drillers and helpers will understand and use the “Show Me Your Hands” Policy. Operator and helpers will remain a **minimum of 3 feet** from augers/drill rods while in operation.
	3d. CONTACT/CRUSH: Crushed between equipment due to imbalance during advancement of drill equipment.	3d. Drillers will advance the borehole with caution to avoid causing the rig to become imbalanced and/or tip. 3d. The blocking and leveling devices used to secure the rig will be inspected by drillers and Roux personnel regularly to see if shifting has occurred. 3d. In addition, personnel and equipment that are non-essential to the advancement of the borehole will be positioned away from the rig at a distance that is at least as far as the boom is high (**minimum exclusion zone of 10 feet**).
	3e. EXPOSURE: Inhalation of contamination/vapors.	3e. Air monitoring using a calibrated photoionization detector (PID) will be used to periodically monitor the breathing zone of the work area. 3e. If readings of >5ppm is recorded, the Roux field personnel must temporarily cease work, instruct all Site personnel to step away from the area of elevated readings and inform the Roux PM of the condition. The Roux PM will then recommend additional precautions in accordance with the site-specific health and safety plan.
	3f. FALL: Slip/trip/fall hazards.	3f. Contain drill cuttings and drilling water to prevent slip/trip/fall hazards from developing in work area. 3f. See 1b.
	3g. EXERTION: Potential for muscle strain/injury while installing well casings and/or lifting sonic rods/casings.	3g. Keep back straight and bend at the knees. 3g. Utilize team lifting for objects over 50lbs. 3g. Use mechanical lifting device for odd shaped objects.
4. Decontaminate equipment.	**4a. EXPOSURE:** Contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated groundwater, vapors, chemical in cleaning supplies).	4a. Wear chemical-resistant gloves and safety glasses. 4a. Contain decontamination water so that it does not spill. 4a. Use an absorbent pad to clean spills, if necessary. 4a. See 3b.

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JOB SAFETY ANALYSIS	**Ctrl. No. GEN-023**	DATE: 7/10/2020	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Construction**	WORK ACTIVITY (Description) **Spotting Heavy Machinery**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Levi Curnutte	Project Scientist	Brian Hobbs	Corporate Health & Safety Manager

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

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

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Heavy Machinery (i.e. excavator, payloader, truck, forklift, etc.)

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

EXCLUSION ZONE (EZ): Maintain Minimum Heavy Equipment Exclusion Zone around equipment and loads while it is in motion. The HEEZ must be greater than the swing zone of any moving part of the equipment, tip zone of the equipment, fall zone of the equipment and contents, distance that debris may travel during demolition activities and/or foot print of a structure to be demolished.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Prepare for machine activity.	**1a. CONTACT:** Obstructions in the work area may create contact hazards from machinery. **1b. Fall :** Slip/Trip/Fall	1a. Cordon off the work area with safety barrels/cones and a rigid barrier (snow fence, traffic bar, etc.). Communicate that only necessary personnel should be in the work area. Spotter and equipment operator shall enforce the **EZ.** Operator will not operate but shall remain in the hands-off mode while personnel are within the exclusion zone. 1b. Ensure that work area is flat, level and clear of any obstructions or debris before setting up work zone.
2. Spotting.	**2a. CONTACT:** Machine or load contact with personnel, property, or machinery.	2a. Discuss the specifics of the work with the operator and be clear about any hand signals that will be used. Clearly discuss the limits of the assigned work area and the machine's Exclusion Zone. Maintain Exclusion Zone. The Exclusion Zone shall be delineated by using 42-inch traffic cones/barrels and a fixed rigid barrier. 2a. The Minimum Heavy Equipment Exclusion zone is greater than the swing/tip radius of equipment. 2a. Both the spotter and equipment operators shall have 2-way radios/cellular devices on their persons to ensure audible communication in the event any changes or new hazards may arise. 2a. All workers should stay outside of the Exclusion Zone of all equipment unless operator is stopped and in "Hands Off" mode. **(This includes the spotter unless an exception has been established in the Site-specific JSA).** If the Exclusion Zone must be reduced due to work area restrictions then the spotter and operator shall enforce the reduced Exclusion Zone. 2a. Spotters must make eye contact with the machine operator or all movement ceases until visual contact can be reestablished. 2a. Spotter shall keep an eye out for any issues with the machine the operator may not see and communicate with other work crews and spotters on behalf of the operator. 2a. If the spotter needs to take a break, he must find a replacement before leaving or have the machine stop operations. **No heavy equipment shall operate without a spotter under any circumstances.** 2a. Wear fluorescent clothing/safety vest.

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Assess ¹JOB STEPS	Analyze ²POTENTIAL HAZARDS	Act ³CRITICAL ACTIONS
	2b. FALL: Slip/Trip/Fall	2b. Look where walking to identify and avoid slip/trip/fall hazards. Avoid icy and/or wet surfaces. Remove obstacles if possible. 2b. Use designated walkways during spotting whenever possible.
	2c. CAUGHT: Caught between machinery and nearby objects.	2c. **Maintain Exclusion Zone.** Do not stand between large, loose or fixed objects or structures and the machinery while it is in motion. Keep in sight of operator at all times while being aware of surrounding structures.
	2d. EXPOSURE: Inhalation of exhaust from machinery.	2d. The spotter will position him/herself upwind of the working machinery, when possible. Spotter will also inform others working within the vicinity of the EZ of proper positioning, if applicable.

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JOB SAFETY ANALYSIS	**Cntrl. No. GEN-009**	DATE: 2/11/2015	☐ NEW ☒ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **GENERIC**	WORK TYPE **Hand Tools**	WORK ACTIVITY (Description) **Pre-Clearing activities, including Air Knifing and Soil Vacuuming**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Alyssa Lau	Staff Engineer	Daniel Abberton	SHSM
		Mike Ritorto	Senior Hydrogeologist
		Laura Jensen	Staff Hydrogeologist

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES	☐ GOGGLES ☒ FACE SHIELD (while air knifing) ☒ HEARING PROTECTION (as needed) ☒ SAFETY SHOES: Steel or composite toed	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING: Fluorescent reflective vest or high visibility clothing	☒ GLOVES: Nitrile and cut resistant ☒ OTHER: Dust mask (as needed)

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Required Equipment: Air Knife, Vactor Truck (Vac Truck), Compressor, Hand Tools, Circular Saw, Dust Mask, Photoionization Detector, Multi-Gas Meter, Traffic Cones, Rigid Barrier, Caution Tape, 20 lb. Fire Extinguisher, “Work Area” and/or “Exclusion Zone” Signs

Commitment to LPS – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

EXCLUSION ZONE: A 10 foot exclusion zone will be maintained around air knife and/or soil vacuum operations.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Verify pre-clearance protocol.	1a. **CONTACT**: Underground utility damage; property damage; personal injury. See Site Walk Inspection JSA for potential hazards.	1a. Confirm that local utility companies were contacted prior to drilling. 1a. Walk the Site to evaluate utility markings and review maps (**See Site Walk Inspection JSA for critical actions**). 1a. Review pre-clearing checklist form and sub-surface clearance form. Pre-clearing protocol indicates that clearance must be conducted to a minimum of 5 vertical feet below ground surface or 8 vertical feet below ground surface in the critical zone using hand tools.
2. Mobilize/demobilize and establish work area.	2a. **See Mobilization / Demobilization JSA for potential hazards.**	2a. **See Mobilization / Demobilization JSA for critical actions.**
3. Pre-clear with air knife, water lance, and soil vacuum, and/or clearance with hand tools	3a. **CONTACT**: Flying debris striking face or body	3a. **Maintain 10 foot exclusion zone.** Only (air knife/vac truck) operator and designated helper shall remain within exclusion zone while air knife/vac truck is active. Use the required PPE, including (at a minimum), cut resistant gloves, safety glasses with side shields, and long sleeved shirt. 3a. Wear a face shield to protect face from flying debris when using air knife. 3a. Aim air knife tip away from self and others, so to avoid line-of-fire hazards. 3a. Use anti-whip devices on compressor hoses.
	3b. **EXPOSURE/ENERGY SOURCE**: Inhalation/exposure to hazardous vapors; inhalation/exposure to dust; electrocution.	3b. Monitor breathing zone with a calibrated PID and multi-gas meter. If vapors sustain levels > 5 ppm, the Roux field personnel must temporarily cease work, instruct all Site personnel to step away from the area of elevated readings and inform the Roux Project Manager of the condition. The Roux Project Manager will then recommend additional precautions. 3b. Wear dust masks as needed 3b. Ensure no open flames/heat sources are present within the work area. 3b. No open flames/heat sources. 3b. Ensure vac truck is properly grounded prior to use. 3b. Do not use metal dig bar; use fiberglass or equivalent.
	3c. **CONTACT:** Damage to unknown/known utility with air knife.	3c. Avoid contacting utilities directly with the high pressure air stream and using the air knife tip as a physical digging tool. 3c. Keep the air knife tip constantly moving to reduce direct pressure on a potential utility. 3c. increase the distance between air knife tip and soil/utility. 3c. Continually remove soil slurry from hole with vacuum, which may have an abrasive effect on utility casings.
	3d. **ERGONOMICS** Poor body positioning when handling equipment and materials.	3d. Use proper body positioning and lifting techniques that minimizes muscle strain; keep back straight, lift with legs, keep load close to body, and never reach with a load.

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[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into five types: Contact - victim is struck by or strikes an object; Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift." Avoid general statements such as, "be careful."

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
3. Pre-clearing with air knife and soil vacuum, and/or clearance with hand tools (continued)	3d. **ERGONOMICS**: (continued) Poor body positioning when handling equipment and materials.	3d. Ensure that loads are balanced to reduce the potential for muscle strain. 3d. Two people or a mechanical lifting aid are required when lifting objects over 50 lb. or when the shape makes the object difficult to lift.
	3e. **FALL**: Tripping/falling due to uneven terrain, weather conditions, and materials/equipment stored at the Site.	3e. Inspect walking path for uneven terrain, weather-related hazards (e.g., ice, puddles, snow, etc.), and obstructions prior to mobilizing equipment. 3e. Walk around any stored materials/equipment; do not climb over. Practice good housekeeping. 3e. Use established pathways and walk on stable, secure ground. 3e. Equipment and tools will be stored at the lowest point of potential energy and out of the walkway and immediate work area (i.e., tools should not be propped against walls or nearby equipment or vehicles). 3e. Equipment and tools that are not anticipated to be used will be returned to a storage area that is out of the immediate work area. 3e. Ensure power cords/hoses are grouped when used within the work area. Mark out cords/hoses that cross pathways with traffic cones. 3e. Ensure all Site personnel and equipment stay a minimum of 2 feet from an open hole. Mark out open holes with traffic cones/caution tape, etc. 3e. Pre-cleared location will be finished flush to grade as to prevent a slip/trip hazard.
	3f. **CAUGHT**: Pinch points or amputation points associated with the equipment and vacuum hose.	3f. Always wear cut-resistant gloves when making connections and using hand tools. 3f. Inspect the equipment prior to use for potential pinch points. 3f. Test all emergency shutdown devices prior to using equipment. 3f. Ensure all jewelry is removed, loose clothing is secured, and PPE is secured close to the body. 3f. **All non-essential personnel shall maintain a 10 foot exclusion zone**; position body out of the line-of-fire. 3f. **Drillers and helpers will understand and use the "Show Me Your Hands Policy".**
	3g. **EXPOSURE**: Noise from vac truck and/or air compressor.	3g. Wear hearing protection when vac truck and air compressor are in operation. Otherwise, if sound levels exceed 85 dB, don hearing protection.
4. Move drum to staging area using drum cart.	4a. **EXPOSURE/CONTACT**: Contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated groundwater, soil).	4a. Wear chemically resistant gloves (i.e., Nitrile; worn in addition to cut resistant gloves). 4a. Do not overfill drums. Ensure that the drum lids are attached securely. 4a. Stage all drums in the designated storage area (per Roux Project Manager) and ensure they are labeled.
	4b. **ERGONOMICS**: Muscle strain while maneuvering drums with drum cart/lift gate.	4b. See 3d. Do not overfill drums. Use lift gate on back of truck to load and unload drums or drum cart to transport drums.
	4c. **CAUGHT**: Pinch points or amputation points associated with handling drum lid.	4c. Ensure that fingers are not placed under the lid of the drum. Wear cut-resistant gloves. Use 15/16" ratchet while sealing drum lid.
5. Decontaminate equipment and tools.	5a. **EXPOSURE/CONTACT**: To contamination (e.g., Separate Phase Hydrocarbons (SPH), contaminated groundwater, vapors).	5a. See 4a. 5a. Contain decontamination water (closed lid) so that it does not spill. 5a. Use an absorbent pad to clean spills, if necessary. 5a. Store all impacted materials/PPE in a designated storage container (per Roux Project Manager) and ensure the container is labeled.
	5b. **EXPOSURE**: To chemicals in cleaning solution.	5b. See 4a.

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JOB SAFETY ANALYSIS Ctrl. No. CVD-19	DATE: 04/16/2020	☒ NEW ☐ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Fieldwork**	WORK ACTIVITY (Description) **Working in Areas Affected by Coronavirus**

DEVELOPMENT TEAM	**POSITION / TITLE**	**REVIEWED BY:**	**POSITION / TITLE**
Kristina DeLuca	Health and Safety Specialist	Brian Hobbs	CHSM

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST	☐ GOGGLES	☐ AIR PURIFYING RESPIRATOR	☒ GLOVES – Leather/cut-resistant in field and nitrile as needed
☒ HARD HAT – In field	☐ FACE SHIELD	☐ SUPPLIED RESPIRATOR	☐ OTHER
☐ LIFELINE / BODY HARNESS	☐ HEARING PROTECTION	☒ PPE CLOTHING – High visibility vest in field	
☒ SAFETY GLASSES – In field	☒ SAFETY SHOES – Steel/composite toe in fie		

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Cloth face covering, nitrile gloves, hand soap, water source, hand sanitizer, disinfectant spray and disinfectant wipes.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

SOCIAL DISTANCING: Maintain 6’ of distance between yourself and all other people at all times. If you do not believe the scope of work can be conducted while maintaining this distance, contact your Project Manager immediately.

Assess **[1]JOB STEPS**	**Analyze** **[2]POTENTIAL HAZARDS**	**Act** **[3]CRITICAL ACTIONS**
1. Project Preplanning	N/A	• Review and follow COVID-19 CDC, Roux, Client and local orders/protocols. • Ensure all workers are fit for duty - anyone feeling sick should remain at home even if symptoms do not align with COVID-19. If a worker has been in contact with someone potentially positive or positive for COVID-19, contact your Office Manager. • Determine PPE needs and ensure adequate supply of disinfectant wipes/spray, soap and water or hand sanitizer at Site. Due to high demands and limited supply, plan ahead. • Use the minimum number of employees necessary to safely complete the work.
2. Mobilization	**Exposure:** Becoming infected or infecting co-workers	**Personal/Rental/Roux Owned Vehicle** • Do not carpool. • Use the same vehicle every day and do not share with co-workers. • Verify workers/other people are not approaching vehicle prior to exiting the vehicle. Maintain 6’ of distance from others. • DO not valet your car or allow others to use your car. If necessary, don nitrile gloves and safety glasses and clean/disinfect all high touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (follow manufacturer’s instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. **Public Transportation** • Public transit should not be used unless absolutely necessary. Consider renting a car rather than taking public transit. If public transit is required, wear appropriate PPE and apply social distancing (6 ft). Use proper donning and doffing procedures for nitrile gloves. Wash hands or use hand sanitizer immediately after. **Hotel Stay (Refer to COVID-19 H&S Guidance for more info)** • If a hotel stay is deemed necessary for the given field work, ensure that you disinfect your room upon initial arrival and returning each day. Disinfect all surfaces of your room with an appropriate disinfectant using nitrile gloves. Use proper donning and doffing procedures for nitrile gloves. • Place the “Do Not Disturb” placard on the room while away and limit housekeeping services to the extent feasible during your stay to minimize the reintroduction and spread of the virus from others. Minimize, or avoid entirely, time spent in hotel common areas (i.e., the lobby, dining areas, gyms, etc.). Wash hands or use hand sanitizer often.

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[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

3. Tailgate Meeting	**Exposure:** Becoming infected or infecting co-workers	• Must occur outside or remotely (i.e. video or conference call). • Maintain at least a 6+ ft distance between you and others. • Discuss primary infection prevention measures listed below. • Do not require employees or subcontractors to sign in, the Site Supervisor shall record names on the attendance form. • If the Site has more than 10 workers, separate tailgate meetings should be performed. • Discuss COVID-19 symptoms with coworkers and subcontractors to ensure fitness for duty. Anyone exhibiting signs or symptoms should be instructed to leave the Site, contact your Project Manager.
4. Site Activities	**Exposure:** Becoming infected or infecting co-workers	• Coordinate field activities at the beginning of the day (i.e. Tailgate meeting) to minimize time spent in crowded spaces or overlap while completing job tasks. • Don cloth face coverings as appropriate. • Apply social distancing (6+ ft) when interacting with others. If anyone comes within 6 ft of you while conducting work and your work prevents you from moving away, politely ask them to move back. If others are unable to move from your space, stop work and leave area. • Do not shake hands or touch others. • Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g. nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically (See Appendix A of Roux Interim H&S Guidance for proper glove removal). • If anyone is coughing or sneezing in your vicinity, stop work and leave the area. • Do not work in areas with limited ventilation with others. • Cover your mouth and nose with tissue or paper towel or with your elbow when coughing or sneezing and wash hands or use hand sanitizer immediately after. If sick contact SHSO/PM and leave Site immediately. • Disinfect work surfaces/areas with approved disinfectant you're responsible for (ex: desk, office doorknob, computer, etc.) at least once at the beginning of your shift and at least once at the end of your shift with either sanitizing wipes or disinfectant spray. • Phones should be operated hands free to extent feasible. Sanitize your phone on a regular basis. Disinfection should also take place whenever suspected contaminated material comes in contact with any work surfaces/areas. Wash hands or use hand sanitizer immediately after. • Avoid public spaces and going out to eat by bringing your own lunch to the Site. If performing work in high density urban areas, it is recommended all food must be consumed at or in your vehicle. Wash hands or use hand sanitizer before eating and immediately after.

Primary Infection Prevention Measures

- Wash your hands often with soap and water for at least 20 seconds.
    - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% ethanol or 70% isopropanol. Key times to wash hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
- Do not touch your eyes, face, nose and mouth with unwashed hands.
- Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw potentially contaminated items (e.g. used tissues) in the trash.
- Avoid close contact/secondary contact with people and potentially contaminated surfaces.
    - Apply appropriate social distance (6+ feet).
    - Stop handshaking/touching others and use caution when accessing public spaces.
- Clean and disinfect frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboard, toilets, sinks and field equipment. If surfaces are dirty, they should be cleaned with soap and water prior to disinfection. If surface cannot be cleaned/disinfected, then wash hands or use sanitizer as soon as possible.

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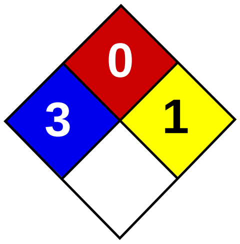
APPENDIX B

Safety Data Sheets for Chemicals Used

ScienceLab.com
Chemicals & Laboratory Equipment



Health	**3**
Fire	**0**
Reactivity	**1**
Personal Protection	

Material Safety Data Sheet

Hydrochloric acid MSDS

Section 1: Chemical Product and Company Identification

Product Name: Hydrochloric acid

Catalog Codes: SLH1462, SLH3154

CAS#: Mixture.

RTECS: MW4025000

TSCA: TSCA 8(b) inventory: Hydrochloric acid

CI#: Not applicable.

Synonym: Hydrochloric Acid; Muriatic Acid

Chemical Name: Not applicable.

Chemical Formula: Not applicable.

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Hydrogen chloride	7647-01-0	20-38
Water	7732-18-5	62-80

Toxicological Data on Ingredients: Hydrogen chloride: GAS (LC50): Acute: 4701 ppm 0.5 hours [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion, . Slightly hazardous in case of inhalation (lung sensitizer). Non-corrosive for lungs. Liquid or spray mist may produce tissue damage particularly on mucous membranes of eyes, mouth and respiratory tract. Skin contact may produce burns. Inhalation of the spray mist may produce severe irritation of respiratory tract, characterized by coughing, choking, or shortness of breath. Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
Slightly hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth. Repeated or prolonged exposure to the substance can produce target

organs damage. Repeated or prolonged contact with spray mist may produce chronic eye irritation and severe skin irritation. Repeated or prolonged exposure to spray mist may produce respiratory tract irritation leading to frequent attacks of bronchial infection. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

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

Skin Contact:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Cover the irritated skin with an emollient. Cold water may be used.Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek immediate medical attention.

Ingestion:
If swallowed, do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention immediately.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: of metals

Explosion Hazards in Presence of Various Substances: Non-explosive in presence of open flames and sparks, of shocks.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards:
Non combustible. Calcium carbide reacts with hydrogen chloride gas with incandescence. Uranium phosphide reacts with hydrochloric acid to release spontaneously flammable phosphine. Rubidium acetylene carbides burns with slightly warm hydrochloric acid. Lithium silicide in contact with hydrogen chloride becomes incandescent. When dilute hydrochloric acid is used, gas spontaneously flammable in air is evolved. Magnesium boride treated with concentrated hydrochloric acid produces spontaneously flammble gas. Cesium acetylene carbide burns hydrogen chloride gas. Cesium carbide ignites in contact with hydrochloric acid unless acid is dilute. Reacts with most metals to produce flammable Hydrodgen gas.

Special Remarks on Explosion Hazards:

Hydrogen chloride in contact with the following can cause an explosion, ignition on contact, or other violent/vigorous reaction: Acetic anhydride AgClO + CCl4 Alcohols + hydrogen cyanide, Aluminum Aluminum-titanium alloys (with HCl vapor), 2-Amino ethanol, Ammonium hydroxide, Calcium carbide Ca3P2 Chlorine + dinitroanilines (evolves gas), Chlorosulfonic acid Cesium carbide Cesium acetylene carbide, 1,1-Difluoroethylene Ethylene diamine Ethylene imine, Fluorine, HClO4 Hexalithium disilicide H2SO4 Metal acetylides or carbides, Magnesium boride, Mercuric sulfate, Oleum, Potassium permanganate, beta-Propiolactone Propylene oxide Rubidium carbide, Rubidium, acetylene carbide Sodium (with aqueous HCl), Sodium hydroxide Sodium tetraselenium, Sulfonic acid, Tetraselenium tetranitride, U3P4 , Vinyl acetate. Silver perchlorate with carbon tetrachloride in the presence of hydrochloric acid produces trichloromethyl perchlorate which detonates at 40 deg. C.

Section 6: Accidental Release Measures

Small Spill:
Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container. If necessary: Neutralize the residue with a dilute solution of sodium carbonate.

Large Spill:
Corrosive liquid. Poisonous liquid. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Use water spray curtain to divert vapor drift. Use water spray to reduce vapors. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Neutralize the residue with a dilute solution of sodium carbonate. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up.. Keep container dry. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Never add water to this product. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, organic materials, metals, alkalis, moisture. May corrode metallic surfaces. Store in a metallic or coated fiberboard drum using a strong polyethylene inner package.

Storage: Keep container tightly closed. Keep container in a cool, well-ventilated area.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Face shield. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves. Boots.

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

Exposure Limits:
CEIL: 5 (ppm) from OSHA (PEL) [United States] CEIL: 7 (mg/m3) from OSHA (PEL) [United States] CEIL: 5 from NIOSH CEIL: 7 (mg/m3) from NIOSH TWA: 1 STEL: 5 (ppm) [United Kingdom (UK)] TWA: 2 STEL: 8 (mg/m3) [United Kingdom (UK)]Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.

Odor: Pungent. Irritating (Strong.)

Taste: Not available.

Molecular Weight: Not applicable.

Color: Colorless to light yellow.

pH (1% soln/water): Acidic.

Boiling Point:
108.58 C @ 760 mm Hg (for 20.22% HCl in water) 83 C @ 760 mm Hg (for 31% HCl in water) 50.5 C (for 37% HCl in water)

Melting Point:
-62.25°C (-80°F) (20.69% HCl in water) -46.2 C (31.24% HCl in water) -25.4 C (39.17% HCl in water)

Critical Temperature: Not available.

Specific Gravity:
1.1- 1.19 (Water = 1) 1.10 (20%and 22% HCl solutions) 1.12 (24% HCl solution) 1.15 (29.57% HCl solution) 1.16 (32% HCl solution) 1.19 (37% and 38%HCl solutions)

Vapor Pressure: 16 kPa (@ 20°C) average

Vapor Density: 1.267 (Air = 1)

Volatility: Not available.

Odor Threshold: 0.25 to 10 ppm

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water, diethyl ether.

Solubility: Soluble in cold water, hot water, diethyl ether.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Incompatible materials, water

Incompatibility with various substances:
Highly reactive with metals. Reactive with oxidizing agents, organic materials, alkalis, water.

Corrosivity:
Extremely corrosive in presence of aluminum, of copper, of stainless steel(304), of stainless steel(316). Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Reacts with water especially when water is added to the product. Absorption of gaseous hydrogen chloride on mercuric sulfate becomes violent @ 125 deg. C. Sodium reacts very violently with gaseous hydrogen chloride. Calcium phosphide and hydrochloric acid undergo very energetic reaction. It reacts with oxidizers releasing chlorine gas. Incompatible with, alkali metals, carbides, borides, metal oxides, vinyl acetate, acetylides, sulphides, phosphides, cyanides, carbonates. Reacts with most metals to produce flammable Hydrogen gas. Reacts violently (moderate reaction with heat of evolution) with water especially when water is added to the product. Isolate hydrogen chloride from heat, direct sunlight, alkalies (reacts vigorously), organic materials, and oxidizers (especially nitric acid and chlorates), amines, metals, copper and alloys (e.g. brass), hydroxides, zinc (galvanized materials), lithium silicide (incandescence), sulfuric acid(increase in temperature and pressure) Hydrogen chloride gas is emitted when this product is in contact with sulfuric acid. Adsorption of Hydrochloric Acid onto silicon dioxide results in exothmeric reaction. Hydrogen chloride causes aldehydes and epoxides to violently polymerize. Hydrogen chloride or Hydrochloric Acid in contact with the folloiwng can cause explosion or ignition on contact or

Special Remarks on Corrosivity:

Highly corrosive. Incompatible with copper and copper alloys. It attacks nearly all metals (mercury, gold, platinium, tantalum, silver, and certain alloys are exceptions). It is one of the most corrosive of the nonoxidizing acids in contact with copper alloys. No corrosivity data on zinc, steel. Severe Corrosive effect on brass and bronze

Polymerization: Will not occur.

Section 11: Toxicological Information

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

Toxicity to Animals:
Acute oral toxicity (LD50): 900 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 1108 ppm, 1 hours [Mouse]. Acute toxicity of the vapor (LC50): 3124 ppm, 1 hours [Rat].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: Classified 3 (Not classifiable for human.) by IARC [Hydrochloric acid]. May cause damage to the following organs: kidneys, liver, mucous membranes, upper respiratory tract, skin, eyes, Circulatory System, teeth.

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

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Doses (LDL/LCL) LDL [Man] -Route: Oral; 2857 ug/kg LCL [Human] - Route: Inhalation; Dose: 1300 ppm/30M LCL [Rabbit] - Route: Inhalation; Dose: 4413 ppm/30M

Special Remarks on Chronic Effects on Humans:
May cause adverse reproductive effects (fetoxicity). May affect genetic material.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Corrosive. Causes severe skin irritation and burns. Eyes: Corrosive. Causes severe eye irritation/conjuntivitis, burns, corneal necrosis. Inhalation: May be fatal if inhaled. Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract. Inhalation of hydrochloric acid fumes produces nose, throat, and larryngeal burning, and irritation, pain and inflammation, coughing, sneezing, choking sensation, hoarseness, laryngeal spasms, upper respiratory tract edema, chest pains, as well has headache, and palpitations. Inhalation of high concentrations can result in corrosive burns, necrosis of bronchial epithelium, constriction of the larynx and bronchi, nasospetal perforation, glottal closure, occur, particularly if exposure is prolonged. May affect the liver. Ingestion: May be fatal if swallowed. Causes irritation and burning, ulceration, or perforation of the gastrointestinal tract and resultant peritonitis, gastric hemorrhage and infection. Can also cause nausea, vomitting (with "coffee ground" emesis), diarrhea, thirst, difficulty swallowing, salivation, chills, fever, uneasiness, shock, strictures and stenosis (esophogeal, gastric, pyloric). May affect behavior (excitement), the cardiovascular system (weak rapid pulse, tachycardia), respiration (shallow respiration), and urinary system (kidneys- renal failure, nephritis). Acute exposure via inhalation or ingestion can also cause erosion of tooth enamel. Chronic Potential Health Effects: dyspnea, bronchitis. Chemical pneumonitis and pulmonary edema can also

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: Class 8: Corrosive material

Identification: : Hydrochloric acid, solution UNNA: 1789 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Hydrochloric acid Illinois toxic substances disclosure to employee act: Hydrochloric acid Illinois chemical safety act: Hydrochloric acid New York release reporting list: Hydrochloric acid Rhode Island RTK hazardous substances: Hydrochloric acid Pennsylvania RTK: Hydrochloric acid Minnesota: Hydrochloric acid Massachusetts RTK: Hydrochloric acid Massachusetts spill list: Hydrochloric acid New Jersey: Hydrochloric acid New Jersey spill list: Hydrochloric acid Louisiana RTK reporting list: Hydrochloric acid Louisiana spill reporting: Hydrochloric acid California Director's List of Hazardous Substances: Hydrochloric acid TSCA 8(b) inventory: Hydrochloric acid TSCA 4(a) proposed test rules: Hydrochloric acid SARA 302/304/311/312 extremely hazardous substances: Hydrochloric acid SARA 313 toxic chemical notification and release reporting: Hydrochloric acid CERCLA: Hazardous substances.: Hydrochloric acid: 5000 lbs. (2268 kg)

Other Regulations:
OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS D-2A: Material causing other toxic effects (VERY TOXIC). CLASS E: Corrosive liquid.

DSCL (EEC):
R34- Causes burns. R37- Irritating to respiratory system. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S45- In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

HMIS (U.S.A.):

- **Health Hazard:** 3
- **Fire Hazard:** 0
- **Reactivity:** 1
- **Personal Protection:**

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

- **Health:** 3
- **Flammability:** 0
- **Reactivity:** 1
- **Specific hazard:**

Protective Equipment:
Gloves. Full suit. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Face shield.

Section 16: Other Information

References:

-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

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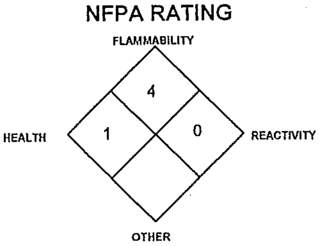

MATERIAL SAFETY DATA SHEET

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

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

1. PRODUCT IDENTIFICATION

CHEMICAL NAME; CLASS:	**ISOBUTYLENE - C_4H_8** Document Number: Isobutylene
PRODUCT USE:	For general analytical/synthetic chemical uses.
SUPPLIER/MANUFACTURER'S NAME: ADDRESS:	MESA Specialty Gases & Equipment 3619 Pendleton Avenue, Suite C Santa Ana, CA 92704
BUSINESS PHONE: EMERGENCY PHONE:	1-714-434-7102 INFOTRAC: 1-800-535-5053
DATE OF PREPARATION:	May 10, 1999

2. COMPOSITION and INFORMATION ON INGREDIENTS

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

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

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

3. HAZARD IDENTIFICATION

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

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

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

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

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

HAZARDOUS MATERIAL INFORMATION SYSTEM

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

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For routine industrial applications

See Section 16 for Definition of Ratings

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

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

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

TARGET ORGANS: Respiratory system.

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

4. FIRST-AID MEASURES

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

4. FIRST-AID MEASURES (Continued)

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

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

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

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5. FIRE-FIGHTING MEASURES

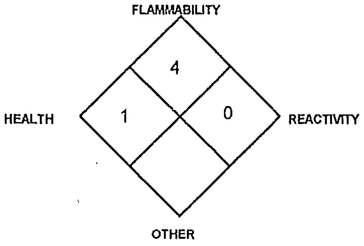
FLASH POINT (Closed Cup): -10°C (< 14°F)
AUTOIGNITION TEMPERATURE: 465°C (869°F)
FLAMMABLE LIMITS (in air by volume, %):

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

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

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

NFPA RATING



See Section 16 for Definition of Ratings

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

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

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

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6. ACCIDENTAL RELEASE MEASURES

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

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

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

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

7. HANDLING and STORAGE

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

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

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

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

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

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

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

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

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

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

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

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

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

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

9. PHYSICAL and CHEMICAL PROPERTIES

VAPOR DENSITY @ 21.1°C (70°F): 2.396 kg/m^3 (0.1496 lb/ft^3)
SPECIFIC GRAVITY (air = 1): 1.997
SOLUBILITY IN WATER: Insoluble.
EVAPORATION RATE (nBuAc = 1): Not applicable.
ODOR THRESHOLD: Not established.
COEFFICIENT WATER/OIL DISTRIBUTION: Not applicable.

pH: Not applicable.
FREEZING POINT: -140°C (-220.6°F)
BOILING POINT @ 1 atm: -6.9°C (19.6°F)
EXPANSION RATIO: Not applicable
VAPOR PRESSURE (psia): 39
SPECIFIC VOLUME (ft^3/lb): 6.7

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

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

10. STABILITY and REACTIVITY

STABILITY: Stable.

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

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

HAZARDOUS POLYMERIZATION: Will not occur.

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

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

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The following information is for pure Isobutylene.

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

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

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

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

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

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

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

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

11. TOXICOLOGICAL INFORMATION (Continued)

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

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

12. ECOLOGICAL INFORMATION

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

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

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

13. DISPOSAL CONSIDERATIONS

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

14. TRANSPORTATION INFORMATION

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

For Isobutylene Gas:
PROPER SHIPPING NAME: Isobutylene
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1055
PACKING GROUP: Not Applicable
DOT LABEL(S) REQUIRED: Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115

Alternate Description:
PROPER SHIPPING NAME: Petroleum gases, liquefied
HAZARD CLASS NUMBER and DESCRIPTION: 2.1 (Flammable Gas)
UN IDENTIFICATION NUMBER: UN 1075
PACKING GROUP: Not Applicable
DOT LABEL(S) REQUIRED: Flammable Gas
NORTH AMERICAN EMERGENCY RESPONSE GUIDEBOOK NUMBER (1996): 115
MARINE POLLUTANT: Isobutylene is not classified by the DOT as a Marine Pollutant (as defined by 49 CFR 172.101, Appendix B).

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

15. REGULATORY INFORMATION

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

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

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

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

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

15. REGULATORY INFORMATION (Continued)

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

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

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

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

LABELING:

DANGER:

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

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

FIRST AID:

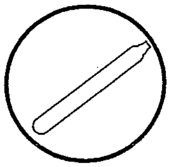
IF INHALED, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

IN CASE OF FROSTBITE, obtain immediate medical attention.

DO NOT REMOVE THIS PRODUCT LABEL.

CANADIAN WHMIS SYMBOLS:

Class A: Compressed Gas
Class B1: Flammable Gas



16. OTHER INFORMATION

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

DEFINITIONS OF TERMS

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

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

EXPOSURE LIMITS IN AIR:

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

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

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

HAZARD RATINGS:

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

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

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

FLAMMABILITY LIMITS IN AIR:

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

TOXICOLOGICAL INFORMATION:

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

REGULATORY INFORMATION:

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

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

1 Identification of the substance/mixture and of the supplier

1.1 GHS Product identifier

Trade Name: Alconox®

Product number: 1101, 1103, 1104, 1104-1, 1112, 1112-1, 1125, 1150

1.2 Application of the substance / the mixture: Cleaning material/Detergent

1.2.1 Recommended dilution ratio: 1 – 2% in water

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer:
Alconox Inc.
30 Glenn St
White Plains, NY 10603
(914) 948-4040

Supplier:

Emergency telephone number:
ChemTel Inc
North America: 1-888-255-3924
International: +1 813-248-0573

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272, 29CFR1910/1200 and GHS requirements.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Eye damage, category 1.

Skin irritation, category 2.

Product at recommended dilution:

Eye irritation, category 2B

Hazard pictograms:

Signal word: Danger

Hazard statements:
H315 Causes skin irritation.
H318 Causes serious eye damage.

Precautionary statements:
P264 Wash skin thoroughly after handling.

P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Hazardous Elements at Use Dilution:

Hazard Pictograms:

Signal Word: Warning

Hazard Statements:

H320 Causes eye irritation

Precautionary statements:

P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P501 Dispose of contents and container as instructed in Section 13

Additional information: None.

Hazard description

Hazards Not Otherwise Classified (HNOC): May cause surfaces to become slippery if wet. Use caution in areas of foot traffic if on floors.

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272, 29CFR1910/1200 and GHS Requirements, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization: Not determined or not available.

3.2 Description: None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2; H315 Eye Dam. 1; H318	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2; H315 Eye Irrit. 2; H319	2-16

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020
Trade Name: Alconox®

Hazardous components at use dilution (percentages by weight):

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Eye Irrit. 2; H319	0.12 - 0.28
CAS number: 68081-81-2 or 68411-30-3	Sodium Alkylbenzene Sulfonate	Eye Irrit. 2; H319	0.08 – 0.22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Eye Irrit. 2; H319	0.02 – 0.16

3.4 Additional Information: None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:
Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

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

No additional information.

First aid measure at recommended dilution:

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.

After swallowing:
Rinse mouth thoroughly. Seek medical attention if irritation, discomfort, or vomiting develops.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents: None

5.2 Special hazards arising from the substance or mixture:

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information:

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures:

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions:

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up:

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections: None

7 Handling and storage

7.1 Precautions for safe handling:

No expected hazards under normal use condition.

Avoid breathing mist or vapor if aerosolized.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities:

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

Safety Data Sheet

Effective date: 11 May 2020 **Revision**: 11 May 2020

Trade Name: Alconox®

8 Exposure controls/personal protection

8.1 Control parameters:

a) 7722-88-5, Tetrasodium Pyrophosphate, ACGIH TWA 10 mg/m3
b) 7758-29-4, Sodium Tripolyphosphate, ACGIH TWA 10 mg/m3
c) Dusts, non-specific OEL, Irish Code of Practice
  (i) Total inhalable 10 mg/m3 (8hr)
  (ii) Respirable 4 mg/m3 (8hr)
  (iii) Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3, (8hr)

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal use conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection. Recommended to comply with ANSI Z87.1 and/or EN 166.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

Exposure Control and Personal Protective Equipment at recommended dilution:

Under normal use and operational conditions, no special personal protective equipment or engineering controls will be necessary. Handle with care.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or notavailable. Not determined or notavailable.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or notavailable.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or notavailable.
pH-value:	9.5 (1% aqueous solution)	**Relative density**:	Not determined or notavailable.

Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or notavailable.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or notavailable.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or notavailable.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or notavailable.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity: Not determined or not available.
10.2 Chemical stability: Not determined or not available.
10.3 Possibility hazardous reactions: Not determined or not available.
10.4 Conditions to avoid: Not determined or not available.
10.5 Incompatible materials: Not determined or not available.
10.6 Hazardous decomposition products: Not determined or not available.

11 Toxicological information

11.1 Information on toxicological effects:

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product.

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation.

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye damage.

Tetrasodium Pyrophosphate: Risk of serious damage to eyes.

Product information at recommended dilution:

Eye irritation may occur upon direct contact with eyes. No specific hazards for skin contact, inhalation, or chronic exposure are expected within normal use parameters.

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.9 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA	None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA	None
14.3 Transport hazard classes: ADR, ADN, DOT, IMDG, IATA	**Class:** None **Label:** None **LTD. QTY:** None

US DOT
Limited Quantity Exception: None

Bulk:	**Non Bulk:**
RQ (if applicable): None	**RQ (if applicable):** None
Proper shipping Name: None	**Proper shipping Name:** None
Hazard Class: None	**Hazard Class:** None
Packing Group: None	**Packing Group:** None
Marine Pollutant (if applicable): No additional information.	**Marine Pollutant (if applicable):** No additional information.

	Comments: None	**Comments:** None
14.4	**Packing group:** ADR, ADN, DOT, IMDG, IATA	None
14.5	**Environmental hazards**:	None
14.6	**Special precautions for user:**	None
	Danger code (Kemler):	None
	EMS number:	None
	Segregation groups:	None

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

14.8 Transport/Additional information:

Transport category:	None
Tunnel restriction code:	None
UN "Model Regulation":	None

15 Regulatory information

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

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed as active.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

EC 648/2004 – This is an industrial detergent. Contains >30% phosphate, 15-30% anionic surfactant, <5% EDTA salts

EC 551/2009 – This is not a laundry or dishwasher detergent

EC 907/2006 – Contains no enzymes, optical brighteners, perfumes, allergenic fragrances, or preservative agents

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H318 Causes serious eye damage.

NFPA: 1-0-0
HMIS: 1-0-0

At recommended dilution:
NFPA: 1-0-0
HMIS: 1-0-0

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

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

Section 1: IDENTIFICATION

Product Name: Simple Green® All-Purpose Cleaner
Additional Names:

Manufacturer's Part Number: **Please refer to Section 16*

Recommended Use: Cleaner & Degreaser for water tolerant surfaces.
Restrictions on Use: Do not use on non-rinsable surfaces.

Company: Sunshine Makers, Inc.
15922 Pacific Coast Highway
Huntington Beach, CA 92649 USA

Telephone: 800-228-0709 ● 562-795-6000 *Mon – Fri, 8am – 5pm PST*
Fax: 562-592-3830
Email: info@simplegreen.com

Emergency Phone: Chem-Tel 24-Hour Emergency Service: 800-255-3924

Section 2: HAZARDS IDENTIFICATION

This product is not classified as hazardous under 2012 OSHA Hazard Communication Standards (29 CFR 1910.1200).

OSHA HCS 2012
Label Elements
Signal Word: None **Hazard Symbol(s)/Pictogram(s):** None required

Hazard Statements: None
Precautionary Statements: None
Hazards Not Otherwise Classified (HNOC): None
Other Information: None Known

Section 3: COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	CAS Number	Percent Range
Water	7732-18-5	> 84.8%*
Ethoxylated Alcohol	68439-46-3	< 5%*
Sodium Citrate	68-04-2	< 5%*
Tetrasodium *N,N*-bis(carboxymethyl)-L-glutamate	51981-21-6	< 1%*
Sodium Carbonate	497-19-8	< 1%*
Citric Acid	77-92-9	< 1%*
Isothiazolinone mixture	55965-84-9	< 0.2%*
Fragrance	Proprietary Mixture	< 1%*
Colorant	Proprietary Mixture	< 1%*

**specific percentages of composition are being withheld as a trade secret*

Section 4: FIRST-AID MEASURES

Inhalation: Not expected to cause respiratory irritation. If adverse effect occurs, move to fresh air.
Skin Contact: Not expected to cause skin irritation. If adverse effect occurs, rinse skin with water.
Eye Contact: Not expected to cause eye irritation. If adverse effect occurs, flush eyes with water.
Ingestion: May cause upset stomach. Drink plenty of water to dilute. See section 11.

Most Important Symptoms/Effects, Acute and Delayed: None known.

Indication of Immediate Medical Attention and Special Treatment Needed, if necessary: Treat symptomatically

Section 5: FIRE-FIGHTING MEASURES

Suitable & Unsuitable Extinguishing Media:	Use Dry chemical, CO2, water spray or “alcohol” foam. Avoid high volume jet water.
Specific Hazards Arising from Chemical:	In event of fire, fire created carbon oxides may be formed.
Special Protective Actions for Fire-Fighters:	Wear positive pressure self-contained breathing apparatus; Wear full protective clothing.

See section 16 for NFPA rating.

Section 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures: *For non-emergency and emergency personnel:* See section 8 – personal protection. Avoid eye contact. Safety goggles suggested.

Environmental Precautions: Do not allow into open waterways and ground water systems.

Methods and Materials for Containment and Clean Up: Dike or soak up with inert absorbent material. See section 13 for disposal considerations.

Section 7: HANDLING AND STORAGE

Precautions for Safe Handling: Ensure adequate ventilation. Keep out of reach of children. Keep away from heat, sparks, open flame and direct sunlight. Do not pierce any part of the container. Do not mix or contaminate with any other chemical. Do not eat, drink or smoke while using this product.

Conditions for Safe Storage including Incompatibilities: Keep container tightly closed. Keep in cool dry area. Avoid prolonged exposure to sunlight. Do not store at temperatures above 109°F (42.7°C). If separation occurs, mix the product for reconstitution.

Section 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Limit Values: No components listed with TWA or STEL values under OSHA or ACGIH.

Appropriate Engineering Controls: Showers, eyewash stations, ventilation systems

Individual Protection Measures / Personal Protective Equipment (PPE)

Eye Contact:	Use protective glasses or safety goggles if splashing or spray-back is likely.
Respiratory:	Use in well ventilated areas or local exhaust ventilations when cleaning small spaces.
Skin Contact:	Use protective gloves (any material) when used for prolonged periods or dermally sensitive.
General Hygiene Considerations:	Wash thoroughly after handling and before eating or drinking.

Section 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Green Liquid
Odor:	Added sassafras odor
Odor Threshold:	Not determined
pH ASTM D-1293:	8.5 – 9.5
Freezing Point ASTM D-1177:	0-3.33°C (32-38°F)
Boiling Point & Range ASTM D-1120:	101°C (213.8°F)
Flash Point ASTM D-93:	> 212°F
Evaporation Rate ASTM D-1901:	½ Butyl Acetate @ 25°C
Flammability (solid, gas):	Not applicable
Upper/Lower Flammability or Explosive Limits:	Not applicable
Vapor Pressure ASTM D-323:	0.60 PSI @77°F, 2.05 PSI @100°F
Vapor Density:	Not determined

Partition Coefficient: n-octanol/water:	Not determined
Autoignition Temperature:	Non-flammable
Decomposition Temperature:	109°F
Viscosity:	Like water
Specific Gravity ASTM D-891:	1.01 – 1.03

VOCs:			**Water & fragrance exemption in calculation
SCAQMD 304-91 / EPA 24:	0 g/L	0 lb/gal	0%
CARB Method 310**:	2.5 g/L	0.021 lb/gal	0.25%
SCAQMD Method 313:	Not tested		

VOC Composite Partial Pressure:	Not determined
Relative Density ASTM D-4017:	8.34 – 8.42 lb/gal
Solubility:	100% in water

Section 10: STABILITY AND REACTIVITY

Reactivity:	Non-reactive.
Chemical Stability:	Stable under normal conditions 70°F (21°C) and 14.7 psig (760 mmHg).
Possibility of Hazardous Reactions:	None known.
Conditions to Avoid:	Excessive heat or cold.
Incompatible Materials:	Do not mix with oxidizers, acids, bathroom cleaners, or disinfecting agents.
Hazardous Decomposition Products:	Normal products of combustion - CO, CO2.

Section 11: TOXICOLOGICAL INFORMATION

Likely Routes of Exposure:	Inhalation -	Overexposure may cause headache.
	Skin Contact -	Not expected to cause irritation, repeated contact may cause dry skin.
	Eye Contact -	Not expected to cause irritation.
	Ingestion -	May cause upset stomach.

Symptoms related to the physical, chemical and toxicological characteristics: no symptoms expected under typical use conditions.
Delayed and immediate effects and or chronic effects from short term exposure: no symptoms expected under typical use conditions.
Delayed and immediate effects and or chronic effects from long term exposure: headache, dry skin, or skin irritation may occur.
Interactive effects: Not known.

Numerical Measures of Toxicity

Acute Toxicity:	Oral LD_{50} (rat)	> 5 g/kg body weight
	Dermal LD_{50} (rabbit)	> 5 g/kg body weight

Calculated via OSHA HCS 2012 / Globally Harmonized System of Classification and Labelling of Chemicals

Skin Corrosion/Irritation:	Non-irritant per Dermal Irritection® assay modeling. No animal testing performed.
Eye Damage/Irritation:	Minimal irritant per Ocular Irritection® assay modeling. No animal testing performed.
Germ Cell Mutagenicity:	Mixture does not classify under this category.
Carcinogenicity:	Mixture does not classify under this category.
Reproductive Toxicity:	Mixture does not classify under this category.
STOT-Single Exposure:	Mixture does not classify under this category.
STOT-Repeated Exposure:	Mixture does not classify under this category.
Aspiration Hazard:	Mixture does not classify under this category.

Section 12: ECOLOGICAL INFORMATION

Ecotoxicity:	Volume of ingredients used does not trigger toxicity classifications under the Globally Harmonized System of Classification and Labelling of Chemicals.
Aquatic:	Aquatic Toxicity - Low, based on OECD 201, 202, 203 + Microtox: EC_{50} & IC_{50} ≥100 mg/L. Volume of ingredients used does not trigger toxicity classifications under the Globally Harmonized System of Classification and Labelling of Chemicals.
Terrestrial:	Not tested on finished formulation.

Persistence and Degradability:	Readily Biodegradable per OCED 301D, Closed Bottle Test
Bioaccumulative Potential:	No data available.
Mobility in Soil:	No data available.
Other Adverse Effects:	No data available.

Section 13: DISPOSAL CONSIDERATIONS

Unused or Used Liquid: May be considered hazardous in your area depending on usage and tonnage of disposal – check with local, regional, and or national regulations for appropriate methods of disposal.

Empty Containers: May be offered for recycling.

Never dispose of used degreasing rinsates into lakes, streams, and open bodies of water or storm drains.

Section 14: TRANSPORT INFORMATION

U.N. Number:	Not applicable	**U.N. Proper Shipping Name:**	Cleaning Compound, Liquid NOI
Transport Hazard Class(es):	Not applicable	**NMFC Number:**	48580-3
Packing Group:	Not applicable	**Class:**	55
Environmental Hazards:	Marine Pollutant - NO		

Transport in Bulk (according to Annex II of MARPOL 73/78 and IBC Code): Unknown.

Special precautions which user needs to be aware of/comply with, in connection with transport or conveyance either within or outside their premises: None known.

U.S. (DOT) / Canadian TDG:	Not Regulated for shipping.	**ICAO/ IATA:**	Not classified as Hazardous
IMO / IDMG:	Not classified as Hazardous	**ADR/RID:**	Not classified as Hazardous

Section 15: REGULATORY INFORMATION

All components are listed on: TSCA and DSL Inventory.

SARA Title III: Sections 311/312 Hazard Categories – Not applicable.
Sections 313 Superfunds Amendments and Reauthorizations Act of 1986 – Not applicable.
Sections 302 – Not applicable.

Clean Air Act (CAA): Not applicable
Clean Water Act (CWA): Not applicable

State Right To Know Lists: No ingredients listed
California Proposition 65: No ingredients listed
Texas ESL:

Ethoxylated Alcohol	68439-46-3	60 µg/m^3 long term	600 µg/m^3 short term
Sodium Citrate	68-04-2	5 µg/m^3 long term	50 µg/m^3 short term
Sodium Carbonate	497-19-8	5 µg/m^3 long term	50 µg/m^3 short term
Citric Acid	77-92-9	10 µg/m^3 long term	100 µg/m^3 short term

Section 16: OTHER INFORMATION

Size	UPC	Size	UPC
2 oz. Pump	043318130366	1 Gallon w/ Dilution Bottle	043318000669
2 oz. Pump	043318131035	1 Gallon	043318000799
4 oz. Pump	043318130014	1 Gallon w/ Dilution Bottle	043318001383
16 oz. Trigger	043318130021	1 Gallon w/ Dilution Bottle	043318002021
22 oz. Trigger	043318130229	1 Gallon	043318130052
24 oz. Trigger, 12 per case	043318000034	1 Gallon w/ Dilution Bottle, 112 per case	043318480140
24 oz. Trigger	043318000300	1 Gallon w/ Dilution Bottle, 4 per case	043318480416
24 oz. Trigger	043318130137	1 Gallon w/ Dilution Bottle, 24 per case	043318480492
32 oz. Trigger	043318000652	1 Gallon w/ laundry	043318002052
32 oz. Trigger	043318130335	1 Gallon w/ towel	043318001222
67.6 oz	043318000393	140 oz.	043318001390
67.6 oz.	043318130144	140 oz., 168 per case	043318561405
1 Gallon w/ Dilution Bottle	043318000539	140 oz. w/ Dilution Bottle	043318001468
1 Gallon w/ Dilution Bottle	043318000645		

USA items listed only. Not all items listed. USA items may not be valid for international sale.

Section 16: OTHER INFORMATION - continued

NFPA:

Health – None
Flammability – Non-flammable

Stability – Stable
Special - None

Acronyms

NTP	National Toxicology Program	IARC	International Agency for Research on Cancer
OSHA	Occupational Safety and Health Administration	CPSC	Consumer Product Safety Commission
TSCA	Toxic Substances Control Act	DSL	Domestic Substances List

Prepared / Revised By: Sunshine Makers, Inc., Regulatory Department.
This SDS has been revised in the following sections: Revised SDS layout

APPENDIX C

COVID-19 Interim Health and Safety Guidance

COVID-19 INTERIM HEALTH AND SAFETY GUIDANCE

CORPORATE HEALTH AND SAFETY MANAGER	**:**	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	**:**	**03/2020**
REVISION DATE	**:**	**03/18/2021**
REVISION NUMBER	**:**	**6**

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APPENDICES

1. PURPOSE

This guidance has been implemented to establish work practices, administrative procedures, and engineering controls to minimize potential exposure to SARS-CoV-2, the virus that causes COVID-19. The following guidance has been developed based on local, state and federal recommendations/requirements regarding COVID-19. The purpose of this document is to supplement existing site-specific Health and Safety Plans (HASPs) and provide interim health and safety guidance to minimize potential exposure to SARS-CoV-2. Should additional scientific information or regulatory information change, this document shall be updated accordingly.

2. SCOPE AND APPLICABILITY

This guidance covers all Roux employees and the subcontractors that Roux oversees. Site specific HASPs shall be developed to incorporate elements of mitigative measures against COVID-19 exposure. If work cannot be carried out in compliance with this guidance, the project shall be further evaluated by the Project Principal (PP), Office Manager (OM), and Corporate Health and Safety Director (CHSD) prior to work authorization.

Roux subcontractors are required to review, comply with, and implement Roux's COVID-19 Interim Health and Safety Guidance while on site. Subcontractors may implement additional preventative measures as they see fit. All work shall be conducted in a manner consistent with the federal, state, and local guidance as it relates to COVID-19.

3. BACKGROUND

What is COVID-19?

COVID-19 is a respiratory illness that can spread from person to person. The virus that causes COVID-19 is a novel coronavirus that was first identified during an investigation into an outbreak in Wuhan, China. This virus continues to spread internationally and within the United States. Multiple variants of the virus that causes COVID-19 are circulating globally. There are currently several vaccines which have been developed which are authorized, recommended and effective at protecting you from getting sick.

What are the symptoms of COVID-19?

Reported illnesses have ranged from mild symptoms to severe illness and death for confirmed COVID-19 cases. Symptoms may appear 2 to 14 days following exposure to the virus. People with these symptoms or combinations of symptoms may have COVID-19:

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

This list is not all possible symptoms. The CDC will continue to update this list as they learn more about the virus. For an updated symptom list please reference the following link for CDC Symptoms of Coronavirus.

If someone develops emergency warning signs for COVID-19, they should be instructed to get medical attention immediately. Emergency warning signs can include those listed below; however, this list is not all inclusive. Please consult your medical provider for any other symptoms that are severe or concerning.

- Trouble breathing
- Persistent pain or pressure in the chest
- New confusion
- Inability to wake or stay awake
- Pale, gray, or blue-colored skin, lips, or nail beds, depending on skin tone

How does COVID-19 spread?[1]

SARS-COV-2 spreads very easily from person to person during close contact.

Individuals who are within close contact (within 6 feet) of a person with COVID-19 or have direct contact with that person are at greatest risk of infection.

- When people with COVID-19 cough, sneeze, sing, talk, or breathe they produce respiratory droplets. These droplets can range in size from larger droplets (some of which are visible) to smaller droplets. Small droplets can also form particles when they dry very quickly in the airstream.
- Infections occur mainly through exposure to respiratory droplets when a person is in close contact with someone who has COVID-19.
- Respiratory droplets cause infection when they are inhaled or deposited on mucous membranes, such as those that line the inside of the nose and mouth.
- As the respiratory droplets travel further from the person with COVID-19, the concentration of these droplets decreases. Larger droplets fall out of the air due to gravity. Smaller droplets and particles spread apart in the air.
- With passing time, the amount of infectious virus in respiratory droplets also decreases.

SARS-CoV-2 can sometimes spread by airborne transmission under certain circumstances.

Some infections can be spread by exposure to virus in small droplets and particles that can linger in the air for minutes to hours. These viruses may be able to infect people who are further than 6 feet away from the person who is infected or after that person has left the space. This kind of spread is referred to as **airborne transmission** and is an important way that infections like tuberculosis, measles, and chicken pox are spread.

- There is evidence that under certain conditions, people with COVID-19 seem to have infected others who were more than 6 feet away. These transmissions occurred within enclosed spaces that had inadequate ventilation. Sometimes the infected person was breathing heavily, for example while singing or exercising.
  - Under these circumstances, scientists believe the amount of infectious smaller droplet and particles produced by the people with COVID-19 became concentrated enough to spread the virus to other people. The people who were infected were in the same space during the same time or shortly after the person with COVID-19 had left.
- Available data indicate it is much more common for the virus that causes COVID-19 to spread through close contact with a person who has COVID-19 than through airborne transmission.[2]

Spread from contact with contaminated surfaces or objects is less common.

Respiratory droplets can also land on surfaces and objects. It is possible that a person could get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose, or eyes. Spread from touching surfaces is not thought to be a common way that COVID-19 spreads.

4. TRAINING REQUIREMENTS

All employees with potential exposure to COVID-19 shall be provided training that incorporates COVID-19 exposure mitigation strategies, such as implementation of proper social distancing, personal hygiene (e.g., handwashing), as well as disinfection procedures, as outlined by CDC guidelines.

5. EXPOSURE RISK POTENTIAL

Worker risk of occupational exposure to COVID-19 can vary from very high, high, medium, or lower (caution) risk. This level of exposure is dependent on several factors, which can include industry type; need for contact within

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[1] How COVID-19 Spreads https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-covid-spreads.html#edn1

[2] Scientific Brief: SARS-CoV-2 and Potential Airborne Transmission | CDC https://www.cdc.gov/coronavirus/2019-ncov/more/scientific-brief-sars-cov-2.html

6 feet of people known to be or suspected of being infected with COVID-19; density of work environment; and industrial setting (i.e., healthcare building, occupied interior work area, minimal ventilation).

Provided below is background risk level information taken from the U.S. Department of Labor Occupational Safety and Health Administration Guidance on preparing workplaces for COVID-19. Risk evaluations for each project shall be conducted by the PP and OM in consultation with the CHSD to ensure Roux employees and subcontractors remain within the lower exposure (caution) category. If it is identified there is a medium exposure risk or higher, further evaluation and mitigative measures shall be evaluated to reduce overall exposure risk prior to work authorization.

Very High Exposure Risk (Activities not conducted by Roux)

Very high exposure risk includes occupations/work activities with high potential for exposure to known or suspected sources of COVID-19 during specific medical, postmortem, or laboratory procedures. This can include but is not limited to:

- Healthcare workers (e.g., doctors, nurses, dentists, paramedics, emergency medical technicians) performing aerosol-generating procedures (e.g., intubation, cough induction procedures, bronchoscopies, some dental procedures and exams, or invasive specimen collection) on known or suspected COVID-19 patients.
- Healthcare or laboratory personnel collecting or handling specimens from known or suspected COVID-19 patients (e.g., manipulating cultures from known or suspected COVID-19 patients).
- Morgue workers performing autopsies, which generally involve aerosol-generating procedures on the bodies of people who are known to have, or suspected of having, COVID-19 at the time of their death.

High Exposure Risk (Activities not conducted by Roux)

High exposure risk occupations/work activities include exposure to known or suspected COVID-19 positive individuals. This can include but not limited to:

- Healthcare delivery and support staff (hospital staff who must enter patients' rooms) exposed to known or suspected COVID-19 patients.
- Medical transport workers (ambulance vehicle operators) moving known or suspected COVID-19 patients in enclosed vehicles.
- Mortuary workers involved in preparing bodies for burial or cremation of people known to have, or suspected of having, COVID-19 at the time of death.
- Those who have frequent or sustained contact with coworkers, including under close working conditions indoors or in poorly ventilated spaces in various types of industrial, manufacturing, agriculture, construction, and other critical infrastructure workplaces.
- Those who have frequent indoor or poorly ventilated contact with the general public, including workers in retail stores, grocery stores or supermarkets, pharmacies, transit and transportation operations, law enforcement and emergency response operations, restaurants, and bars.

Medium Exposure Risk

Medium exposure risk occupations/work activities include those that require frequent and/or close contact with (i.e., within 6 feet for a cumulative total of 15 minutes or more over a 24-hour period)) people who may be infected with COVID-19, but who are not known or suspected to be COVID-19 positive. For most of our worksites, it is assumed there is on-going community transmission for COVID-19. Therefore, workers who work at sites and may have contact with the general public, other contractors, high-population-density work environments (i.e., greater than 10 people) fall within medium exposure risk group category. This can include, but is not limited to, sampling events that require two or more workers to collect and log samples in close contact or work occurring in an interior space with limited ventilation and several workers present.

Lower Exposure Risk (Caution)

Lower exposure risk (caution) occupations/work activities are those that do not require close contact (within 6 feet for a cumulative total of 15 minutes or more over a 24-hour period) with other people. During these activities, there is limited contact (i.e., within 6 feet of) the general public or other workers. Workers in this category have minimal occupational contact with the public and other coworkers. This includes construction oversight that does not require close contact, sampling or gauging events performed by one worker and our remote workers as well as office workers who do not have frequent close contact with coworkers, clients, or the public.

6. COVID-19 HEALTH SCREENING

6.1. Roux Employees

All Roux employees are required to self-attest to a COVID-19 Daily Health Questionnaire which is to be completed at home through a mobile application on scheduled workdays. The purpose of this program is to ensure business continuity as well as mitigate any potential exposure to our employees and others if it is determined employees are at-risk for contracting COVID-19. As part of this self-attestation, all employees are required to take their temperatures daily at home to confirm they do not have a fever ($\geq$ 100.4). Employees who answer yes to any of these questions are instructed to contact their Office Manager and/or Department Head immediately and should not enter the office or go to a field site. Information shall be used to determine appropriate internal response in consultation with the Human Resources Director (HRD) and CHSD.

Below, you will find our COVID-19 Daily Health Questionnaire that all Roux employees are required to self-attest to **every scheduled workday by 9:30 AM.** If employees do not promptly fill out the questionnaire by the time listed above, there will be additional follow up by HR, H&S, and/or OMs.

According to the U.S. Centers for Disease Control and Prevention & the World Health Organization, COVID-19 Symptoms include:

- *Fever ($\geq$100. 4°F) or chills*
- *Cough*
- *Shortness of breath or difficulty breathing*
- *Fatigue*
- *Muscle or body aches*
- *Headache*
- *New loss of taste or smell*
- *Sore throat*
- *Congestion or runny nose*
- *Nausea or vomiting*
- *Diarrhea*

Have you experienced any of the COVID-19 related symptoms noted above in the last 14 days? Please Note: We do not expect employees to answer "yes" to the symptoms question if these are symptoms you normally experience due to another condition or medication.

- *Yes*
- *No*

Have you been in close contact with someone who is suspected or confirmed to have COVID-19 or who is under investigation for COVID-19 within the last 14 days? *Close contact is defined as someone who was within 6 feet of an infected person for at least 15 minutes or coming into direct contact with secretions (e.g., sharing utensils, being coughed on) from an infected person.*

- *Yes*
- *No*

Have you traveled outside of the country, been on a cruise ship and/or traveled to areas within the United States which have state mandated travel restrictions in the last 14 days?

- *Yes*
- *No*

Have you tested positive for COVID-19 within the last 14 days?

- *Yes*
- *No*

6.2. Subcontractors

In an effort to mitigate the risk of transmission of COVID-19, Subcontractors who shall perform work on-site are required to attest to the fitness of their work crew on a daily basis. This requires each worker to self-assess by asking themselves the four questions listed in the section above and also contained within the Roux Subcontractor Work Crew COVID-19 Daily Health Attestation. If any crew member answers “Yes” to any of the questions, that worker is not to report to the field site and should seek proper medical advice, in accordance with local, state and federal guidelines.

On a daily basis, the subcontractor supervisor must provide the Subcontractor Work Crew COVID-19 Daily Health Attestation complete with the names of all work crew fit to be on the site for that day (i.e., who have answered “No” to all questions on the self-assessment) to Roux’s Project Manager or Site Supervisor. The Subcontractor must notify Roux if there have been any “Yes” responses daily. Subcontractors shall not be required to provide the name or any other personal information of any employee who has answered “Yes” to any of the self-assessment questions, however, the subcontractor should provide the date and times that employee has been onsite in the prior 14 days. Records shall be maintained within the project files indicating health screening has been performed, records shall be retained for not less than 14 days following the date of submission. The Roux Subcontractor Work Crew COVID-19 Daily Health Check Attestation can be found within Appendix A.

7. SELF-ISOLATION & QUARANTINE

7.1. Self-Isolation

What if I am asked to self-isolate at home and when can I return from home isolation?

Depending on the situation, if you are COVID-19 positive or suspected to have COVID-19, employees may be required to self-isolate in their homes, as per CDC or local health department guidelines. As per CDC guidance, return from isolation has been broken out into two categories. The first includes confirmed or suspected COVID-19 individuals exhibiting symptoms, and the second includes those who have not had COVID-19 symptoms (i.e., asymptomatic), but tested positive and are under self-isolation. Both categories, along with strategies to return from home isolation, are outlined below.

People with COVID-19 under home isolation:

Accumulating evidence supports ending isolation and precautions for persons with COVID-19 using a symptom-based strategy. Specifically, researchers have reported that people with mild to moderate COVID-19 remain infectious no longer than 10 days after their symptoms began, and those with more severe illness or those who are severely immunocompromised remain infectious no longer than 20 days after their symptoms began. Therefore, CDC has updated the recommendations for discontinuing home isolation as follows:

1. **Persons with COVID-19 who have symptoms** and were directed to care for themselves at home may discontinue isolation under the following conditions:
   a. At least 10 days* have passed since symptom onset;
   b. At least 24 hours have passed since resolution of fever without the use of fever-reducing medications; and
   c. Other symptoms have improved.

   * *A limited number of persons with severe illness may produce replication-competent virus beyond 10 days, which may warrant extending the duration of isolation for up to 20 days after symptom onset. Consultation with your healthcare provider will be warranted in such cases of severe illness.*
2. **Persons infected with SARS-CoV-2 who never develop COVID-19 symptoms** may discontinue isolation and other precautions 10 days after the date of their first positive RT-PCR test for SARS-CoV-2 RNA.

7.2. Quarantine

Employees may be required to self-quarantine due to potential exposure with a suspected and/or confirmed COVID-19 positive individual as well as recent travel as per local/state guidelines. People in quarantine should stay home, separate themselves from others, monitor their health, and follow directions from their state or local health department.

7.2.1. Close Contact Quarantine

Employees who have come into close contact with someone who has COVID-19 are required to self-quarantine for 14 days following their last contact with the COVID-19 positive person. Close contact as defined by the CDC is being within 6 feet of someone who has COVID-19 for a cumulative total of 15 minutes or more over a 24-hour period, providing care at home to someone who is sick with COVID-19, having direct physical contact with COVID-19 individual, sharing utensils with COVID-19 individual, and being sneezed/coughed on by someone with COVID-19. Please note an infected person can spread SARS-CoV-2 starting from 2 days before they have any symptoms (or, for asymptomatic patients, 2 days before the positive specimen collection date), until they meet the criteria for discontinuing home isolation.

Employees who have been fully vaccinated (as per CDC guidance) or who were previously diagnosed with COVID-19 within the last three months and show no symptoms are not required to quarantine. Additional consultation with the HRD and CHSD shall occur in these circumstances.

7.2.2. Travel Related Quarantine

All travel out of state must be communicated with the OM and/or Department Head prior to departure. Please note, some state/local entities require submissions of traveler health forms. It is expected all Roux employees will comply with such state/local travel requirements. All employees returning from international and/or cruise ship travel must quarantine for 10 days from the time they have returned home and avoid being around people who are at increased risk for severe illness for 14 days, whether you get tested or not.

Personal Travel

Employees who will be traveling out of state are responsible for checking the local/state quarantine guidance for the regions they are traveling from and to in advance of travel and notifying their OM prior to traveling in order to evaluate the impact on the business. Based on state/local guidelines you may be required to quarantine for 10 days from the time you have returned home.

Work-Related Travel

The Project Team (i.e., PM & PP) and field staff who will be traveling are responsible for checking the local/state quarantine guidance for the regions they are traveling from and to in advance of travel and notifying their OM prior to traveling in order to evaluate the impact to the business. Additionally, health and safety considerations shall be reviewed by the OM in consultation with the CHSD regarding logistics and overnight accommodations. Based on state/local guidelines, you may be required to quarantine for 10 days from the time you have returned home.

8. WORKPLACE CONTROLS

During the project planning phase, worksite evaluations shall be carried out by the PP and OM in consultation with the CHSD to determine risk exposure levels for work activities. If it is determined there is a medium exposure risk level or higher, additional workplace controls shall be evaluated and implemented as required in addition to the basic infection prevention measures outlined below in Section 8. Additional workplace controls can include engineering controls (i.e., ventilation, physical barriers), administrative controls (i.e., minimizing contact between workers, rotating shifts, site specific training), and additional personal protective equipment (i.e., respiratory protection). If exposure risk cannot be mitigated, potential project postponement may be necessary at the discretion of the OM in consultation with the CHSD.

A Job Safety Analysis (JSA) has been developed and is provided in Appendix B, which summarizes and applies concepts within this guidance including the infection prevention measures listed below. This JSA shall be required for all field work in areas where there is community-based transmission of COVID-19.

9. INFECTION PREVENTION MEASURES

The following is basic infection prevention and personal hygiene practices which shall be implemented for all Roux field activities as well as in the office setting.

- ***Personal Hygiene***
  - Wash your hands often with soap and water for at least 20 seconds.
    - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% ethanol or 70% isopropanol.
    - Key times to wash your hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
  - Do not touch your eyes, face, nose and mouth with unwashed hands.
  - Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow.
  - Throw potentially contaminated items (e.g., used tissues) in the trash.
- ***Avoid Close Contact/Secondary Contact with People and Potentially Contaminated Surfaces***
  - Apply appropriate social distance (6+ feet).
  - Stop handshaking—use and utilize other noncontact methods for greeting.
  - Do not work in areas with limited ventilation with other Site workers (e.g., small work trailer which lacks HVAC system). If working in a trailer, the following conditions must be met: limited to 4 workers, large enough to have the ability to apply social distance and has open windows and/or operational HVAC to ensure proper ventilation of the workspace.
  - Morning tailgate/safety meetings shall occur outside and not within work trailers.
    - Do not require employees or subcontractors to sign in using the same tailgate form. The Site Supervisor/SHSO should record names of those in attendance on the form.
    - If the Site has more than 10 workers, separate tailgate meetings should be performed in smaller groups.
  - Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g., nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically.
  - If receiving labware or other equipment disinfect to the extent feasible. If there are concerns for contaminating labware please wear appropriate PPE (e.g., gloves) to minimize contact.

  - Contact your lab/equipment vendor to confirm equipment is properly disinfected prior to being shipped.
  - Do not carpool with others (e.g., clients, coworkers).
  - For company owned vehicles limit sharing of vehicles with coworkers. If unable to limit sharing of company owned vehicles, properly disinfect vehicle before driving with a focus on commonly touched surfaces (e.g., steering wheels, shifters, buttons, etc.).
  - Use caution when using public restrooms, portable toilets. Use paper towel as a barrier when touching door handles and faucets.
- ***Cleaning and Disinfecting***
  - Clean and disinfect frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboards, toilets, faucets, sinks, and field equipment (i.e., photo-ionization detector, field equipment).
  - **Hard (Non-porous) Surfaces**
    - If surfaces are dirty, they should be cleaned with a detergent/soap and water prior to disinfection.
    - Refer to the manufacturer's instructions to ensure safe and effective use of the product and wear appropriate personal protective equipment (e.g., gloves, safety glasses, face shield).
    - Many products require:
      - Keeping surface wet for a period of time (i.e., contact time)
        - Refer to manufacturer's instructions outlining adequate contact time.
      - Precautions such as wearing gloves and making sure you have good ventilation during use of the product.
    - Disposable gloves should be removed aseptically and discarded after cleaning. Wash hands immediately following removal of gloves. Refer to Appendix C for how to remove gloves aseptically.
    - If products on EPA List N: Disinfectants for Coronavirus (COVID-19) are not available, bleach solutions can be used if appropriate for the surface and will be effective against coronaviruses when properly diluted.
      - Most household bleach contains 5%–9% sodium hypochlorite. Do not use a bleach product if the percentage is not in this range or is not specified, such as some types of laundry bleach or splash-less bleach as these are not appropriate for disinfection.
      - Follow the directions on the bleach bottle for preparing a diluted bleach solution. If your bottle does not have directions, you can make a bleach solution for disinfecting by mixing:
        - 5 tablespoons (1/3 cup) of bleach per gallon of room temperature water OR
        - 4 teaspoons of bleach per quart of room temperature water
      - Follow the manufacturer's application instructions for the surface. If instructions are not available, leave the diluted bleach solution on the surface for at least 1 minute before removing or wiping. This is known as the "contact time" for disinfection. The surface should remain visibly wet during the contact time.
      - Ensure proper ventilation during and after application (for example, open windows).
      - Never mix household bleach (or any disinfectants) with any other cleaners or disinfectants. This can cause vapors that may be very dangerous to breathe in.
      - Make a new diluted bleach solution daily. Bleach solutions will not be as effective after being mixed with water for over 24 hours. Products with EPA-approved emerging viral pathogen claims are expected to be effective against COVID-19. Follow the manufacturer's instructions

for all cleaning and disinfecting products (e.g., concentration, application method and contact time, etc.).

- **Soft (Porous) Surfaces**
  - For soft (porous) surfaces, remove visible contamination if present and clean with appropriate cleaners indicated for use on the surfaces. After cleaning:
    - Launder items as appropriate in accordance with the manufacturer's instructions. If possible, launder using the warmest appropriate water setting for the item and dry items completely; or
    - Use products with the EPA-approved emerging viral pathogens that claim they are suitable for porous surfaces.
- **Electronics**
  - For electronics such as tablets, touch screens, keyboards, remote controls, etc. remove visible contamination if present.
    - Follow the manufacturer's instructions for all cleaning and disinfection products.
    - Consider use of wipeable covers for electronics.
    - If no manufacturer guidance is available, consider the use of alcohol-based wipes or sprays containing at least 70% alcohol to disinfect touch screens. Dry surfaces thoroughly to avoid pooling of liquids.
- ***Linens, Clothing, and Other Items that Go in the Laundry***
  - Although it is unlikely field clothing would become potentially contaminated with COVID-19, it is recommended that field staff regularly launder field clothing following any field event upon returning home.
  - In order to minimize the possibility of dispersing the virus from potentially contaminated clothing, do not shake dirty laundry.
  - Wash items as appropriate in accordance with the manufacturer's instructions. If possible, launder items using the warmest appropriate water setting for the items and dry items completely.
  - Clean and disinfect hampers or other containers used for transporting laundry according to guidance listed above.
- ***Office/Site Specific-Cleaning and Disinfection Protocols***

  Each office and long-term field site has developed internal cleaning and disinfecting practices, which are broken into three categories: routine cleaning; enhanced cleaning and disinfecting; and deep cleaning and disinfecting. In the instance there is someone who is suspected or confirmed positive for COVID-19 and has worked at the office or field site, deep cleaning and disinfecting shall be considered. The CHSD shall work with the OM and Office Health and Safety Manager to evaluate site-specific measures that shall be carried out prior to deep cleaning and disinfecting. This can include, but is not limited to, closing off all areas potentially affected, as determined through contact tracing. Areas should remain closed off for a minimum of 24 hours during this time; if able, ventilation shall be increased in the space (e.g., opening doors, windows, increasing CFM). Following this period, all areas used by the suspected or confirmed COVID-19 individual shall be cleaned and disinfected appropriately. Areas can include, but are not limited to, offices, bathrooms, shared equipment used by the ill person, and common areas with a focus on frequently touched surfaces. If it has been more than seven (7) days since the person with suspected/ confirmed COVID-19 visited or used the facility, additional cleaning and disinfecting is not necessary.

10. CLOTH FACE COVERINGS

The CDC recommends the use of cloth face coverings in public settings where other social distancing measures are difficult to maintain. This recommendation is based on recent studies and an understanding that a significant portion of asymptomatic, as well as pre-symptomatic, individuals can shed the virus to others before showing symptoms. Studies indicate that COVID-19 can spread among people interacting in close proximity through speaking, coughing, or sneezing. The use of cloth face coverings is to supplement and NOT replace the existing practices outlined above.

Based on existing studies and on-going recommendations and/or requirements from federal, state, and local entities, Roux is recommending the use of cloth face coverings, when appropriate. Appropriate use is defined when local authorities or clients require the use of cloth face coverings in conjunction with established social distancing, or if an employee elects to use a cloth covering on their own accord. Roux will provide cloth face coverings that shall meet the basic requirements outlined by the CDC guidance.

Cloth Face Coverings (i.e., masks) should:

- Completely cover the nose and mouth;
- Fit snugly against the sides of the face and not have any gaps;
- Be handled only by the ear loops, cords or head straps (not by the surface of the mask);
- Include multiple layers of fabric;
- Allow for breathing without restriction; and
- Be able to be laundered and machine dried with no damage or change to shape.

When donning and doffing the cloth face covering, individuals should avoid touching their eyes, nose, and mouth. Following removal of the cloth face covering, employees should wash their hands immediately using the guidelines described in Section 8 above. Cloth face coverings should be routinely washed depending on the frequency of use.

Note, the cloth face coverings recommended are not surgical masks or N-95 respirators. Those are critical supplies that must continue to be reserved for healthcare workers and other medical first responders, as recommended by current CDC guidance. Should there be a requirement for workers to be in respiratory protection (e.g., full-face respirator w/cartridges, P100, N95 respirators), it shall be addressed during the project pre-planning phase, which includes discussions with the PP and OM in consultation with CHSD.

Additional information on improving the fit and filtration of your mask can be found at the following CDC website.

11. HOTEL SELECTION PROCESS AND OVERNIGHT/REMOTE WORK

Hotel Selection

If there is a project requiring the overnight stay at a hotel, accommodations shall be made only after the hotel and hotel's location have been vetted in accordance with Roux's established guidance as defined below. The Project Team, which includes the Project Manager (PM) and PP along with the OM, in consultation with the CHSD, shall verify the hotel has appropriate protocols in place to limit the potential exposure and spread of COVID- 19 through proper cleaning and disinfection practices. Discussions with the hotel shall include, but are not limited to, measures taken to keep guests safe during their stay, guest room sanitization schedule, training of staff regarding disinfecting protocols using EPA-approved disinfectants, hotel staff fitness for duty requirements, etc. Some example questions are listed below. Following the initial hotel assessment by the Project Team, the OM and the CHSD shall review the hotel assessment findings prior to the CHSD's authorization that the hotel may be used by any Roux employees.

Sample Questions for Evaluating Hotels

1. Is there an established COVID-19 guidance/policy your location is following?
2. What additional measures are being implemented to keep workers and customers safe?; (e.g. signs/placards, social-distancing/mask reminders)
3. Is there a guest room sanitization schedule?
4. Have staff been trained on properly cleaning/disinfecting areas?

5. What types of disinfectants are in use at your location?
6. How are you evaluating staff fitness for duty? (e.g., temperature checks, not reporting to work when sick, etc.)

Employees staying overnight should abide by the following guidance:

- Ensure you properly disinfect your room upon arrival. This should include a wipe down of all commonly touched surfaces with an approved disinfectant. Use appropriate PPE (e.g., nitrile gloves) when disinfecting surfaces.
- Place the "Do Not Disturb" placard on the room while away and consider limiting hotel housekeeping service to the extent feasible (e.g., not having the room cleaned each day) to minimize potential secondary contact with others.
- Do not spend any more time in hotel common areas (i.e., lobby, hallways, etc.) than is necessary.
- Follow proper Infection Prevention Measures found within Section 8 above.
- Have meals in your hotel room after disinfecting outer package surfaces, as outlined in Section 8 above. Do not eat in public spaces or restaurants.
- If the hotel has a restaurant or café, do not have your meal in a common area; instead order food to be picked up or delivered to your room. If delivered, opt for contactless delivery (left outside the door, delivery person knocks and leaves). Always use your own pen if you need to sign something.
- Employees may also pick up food from takeout locations, order groceries or food for delivery to the hotel. Call local restaurants to order food for delivery (call the hotel lobby for recommendations) or use food ordering apps. Some apps have options for contactless delivery.

12. TRANSPORTATION-RENTAL CARS AND ROUX-OWNED VEHICLES

Rental Cars

If there is a project requiring the use of a rental car (e.g., truck/van), accommodations shall be made only after the rental car company and their store's location have been vetted in accordance with Roux's established guidance, as defined below. The Project Team (PM and PP) and OM in consultation with the CHSD shall verify the rental company where you are picking up your vehicle has appropriate protocols in place to limit the potential exposure and spread of COVID- 19 through proper cleaning and disinfection practices. Discussions with the rental car company shall include, but are not limited to, measures to be taken to keep customers safe during pickup/drop-off, rental car disinfection protocols, training of staff regarding disinfecting protocols using EPA-approved disinfectants, rental car company staff fitness for duty requirements, etc. Some example questions are listed below. Following the initial rental car company store assessment by the Project Team, the OM and the CHSD shall review the rental car company assessment findings prior to the CHSD's authorization that the rental car company store may be used by any Roux employees.

Sample Questions for Evaluating Rental Car Companies

1. Is there an established COVID-19 guidance your location is following?
2. What additional measures are being implemented to keep workers and customers safe?
3. Is there a car sanitization schedule?
4. Have staff been trained on properly cleaning/disinfecting vehicles?
5. What types of disinfections are in use at your location?
6. How are you evaluating staff fitness for duty? (e.g., temperature checks, not reporting to work when sick, etc.)

Upon vehicle pickup, employees shall don nitrile gloves and safety glasses and clean/disinfect all high-touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (following manufacturer's instructions). Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. Due to social distancing requirements, personnel shall not carpool to destinations.

Roux-Owned Vehicles

Roux-owned vehicles should be dedicated to individual employees to the extent feasible, and if authorized by the OM. In the case this cannot be accommodated, employees shall don nitrile gloves and safety glasses, and clean/disinfect all high-touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (following manufacturer's instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. Due to social distancing requirements, personnel shall not carpool to destinations.

APPENDIX A

Roux Subcontractor Work Crew
COVID-19 Daily Health Screening Questionnaire

Subcontractor Work Crew
COVID-19 Daily Health Attestation

Date:

Company Name:

Supervisor Name: Signature:

Project Name:

Site Address:

Number of Workers on site:

Prior to entry onto a field site, the following questions shall be asked by the Subcontractor Supervisor to their work crew.

It is preferred this questionnaire is completed for each individual prior to their arrival at the field site. If the answer to any of these questions is YES, the worker is not to report to the field site and seek proper medical advice, in accordance with CDC Guidelines.

The Subcontractor Supervisor must provide this form on a daily basis to the Roux primary contact for the project and notify Roux of any YES responses.

1. Have you experienced any signs/symptoms of COVID-19 such as fever (≥100.4°F), cough, shortness of breath, chills, fatigue, muscle/body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea/vomiting or diarrhea in the last 14 days?
2. Have you been in close contact* with someone who is suspected or confirmed to have COVID-19 or who is under investigation for COVID-19 within the last 14 days?

*Close contact is defined as someone who was within 6 feet of an infected person for at least 15 minutes or coming into direct contact with secretions (e.g. sharing utensils, being coughed on) from an infected person.

3. Have you traveled outside of the country, been on a cruise ship and/or traveled to areas within the United States which have state mandated travel restrictions in the last 14 days?
4. Have you tested positive for COVID-19 within the last 14 days?

Please list the crew member’s names on site for the day.

1.	9.
2.	10.
3.	11.
4.	12.
5.	13.
6.	14.
7.	15.
8.	16.

APPENDIX B

Job Safety Analysis-Working in Areas Affected by COVID-19

JOB SAFETY ANALYSIS Ctrl. No. CVD-19	DATE: 04/16/2020	☒ NEW ☐ REVISED	PAGE 1 of 2

JSA TYPE CATEGORY **Generic**	WORK TYPE **Fieldwork**	WORK ACTIVITY (Description) **Working in Areas Affected by Coronavirus**

DEVELOPMENT TEAM	POSITION / TITLE	REVIEWED BY:	POSITION / TITLE
Kristina DeLuca	Health and Safety Specialist	Brian Hobbs	CHSM

REQUIRED AND / OR RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT

☐ LIFE VEST ☒ HARD HAT – In field ☐ LIFELINE / BODY HARNESS ☒ SAFETY GLASSES – In field	☐ GOGGLES ☐ FACE SHIELD ☐ HEARING PROTECTION ☒ SAFETY SHOES – Steel/composite toe in fie	☐ AIR PURIFYING RESPIRATOR ☐ SUPPLIED RESPIRATOR ☒ PPE CLOTHING – High visibility vest in field	☒ GLOVES – Leather/cut-resistant in field and nitrile as needed ☐ OTHER

REQUIRED AND / OR RECOMMENDED EQUIPMENT

Cloth face covering, nitrile gloves, hand soap, water source, hand sanitizer, disinfectant spray and disinfectant wipes.

Commitment to Safety – All personnel onsite will actively participate in SPSA performance by verbalizing SPSAs throughout the day.

SOCIAL DISTANCING: Maintain 6’ of distance between yourself and all other people at all times. If you do not believe the scope of work can be conducted while maintaining this distance, contact your Project Manager immediately.

Assess [1]JOB STEPS	Analyze [2]POTENTIAL HAZARDS	Act [3]CRITICAL ACTIONS
1. Project Preplanning	N/A	• Review and follow COVID-19 CDC, Roux, Client and local orders/protocols. • Ensure all workers are fit for duty - anyone feeling sick should remain at home even if symptoms do not align with COVID-19. If a worker has been in contact with someone potentially positive or positive for COVID-19, contact your Office Manager. • Determine PPE needs and ensure adequate supply of disinfectant wipes/spray, soap and water or hand sanitizer at Site. Due to high demands and limited supply, plan ahead. • Use the minimum number of employees necessary to safely complete the work.
2. Mobilization	**Exposure:** Becoming infected or infecting co-workers	**Personal/Rental/Roux Owned Vehicle** • Do not carpool. • Use the same vehicle every day and do not share with co-workers. • Verify workers/other people are not approaching vehicle prior to exiting the vehicle. Maintain 6’ of distance from others. • DO not valet your car or allow others to use your car. If necessary, don nitrile gloves and safety glasses and clean/disinfect all high touch surfaces (steering wheel, knobs, door handles, turn signals, radio, etc.) by wiping thoroughly with approved disinfectants (follow manufacturer’s instructions). This cleaning and disinfection shall occur before and after each use of the vehicle. Aseptically remove gloves and dispose of them along with rags/wipes, appropriately. Wash hands or use hand sanitizer immediately after each episode of cleaning. **Public Transportation** • Public transit should not be used unless absolutely necessary. Consider renting a car rather than taking public transit. If public transit is required, wear appropriate PPE and apply social distancing (6 ft). Use proper donning and doffing procedures for nitrile gloves. Wash hands or use hand sanitizer immediately after. **Hotel Stay (Refer to COVID-19 H&S Guidance for more info)** • If a hotel stay is deemed necessary for the given field work, ensure that you disinfect your room upon initial arrival and returning each day. Disinfect all surfaces of your room with an appropriate disinfectant using nitrile gloves. Use proper donning and doffing procedures for nitrile gloves. • Place the “Do Not Disturb” placard on the room while away and limit housekeeping services to the extent feasible during your stay to minimize the reintroduction and spread of the virus from others. Minimize, or avoid entirely, time spent in hotel common areas (i.e., the lobby, dining areas, gyms, etc.). Wash hands or use hand sanitizer often.

---

[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object;
Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards, energy source; Energy Source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

3. Tailgate Meeting	**Exposure:** Becoming infected or infecting co-workers	• Must occur outside or remotely (i.e. video or conference call). • Maintain at least a 6+ ft distance between you and others. • Discuss primary infection prevention measures listed below. • Do not require employees or subcontractors to sign in, the Site Supervisor shall record names on the attendance form. • If the Site has more than 10 workers, separate tailgate meetings should be performed. • Discuss COVID-19 symptoms with coworkers and subcontractors to ensure fitness for duty. Anyone exhibiting signs or symptoms should be instructed to leave the Site, contact your Project Manager.
4. Site Activities	**Exposure:** Becoming infected or infecting co-workers	• Coordinate field activities at the beginning of the day (i.e. Tailgate meeting) to minimize time spent in crowded spaces or overlap while completing job tasks. • Don cloth face coverings as appropriate. • Apply social distancing (6+ ft) when interacting with others. If anyone comes within 6 ft of you while conducting work and your work prevents you from moving away, politely ask them to move back. If others are unable to move from your space, stop work and leave area. • Do not shake hands or touch others. • Do not share equipment or other items with co-workers and subcontractors unless wearing appropriate PPE (e.g. nitrile gloves). Assume equipment and other surfaces are potentially contaminated and remove gloves aseptically (See Appendix A of Roux Interim H&S Guidance for proper glove removal). • If anyone is coughing or sneezing in your vicinity, stop work and leave the area. • Do not work in areas with limited ventilation with others. • Cover your mouth and nose with tissue or paper towel or with your elbow when coughing or sneezing and wash hands or use hand sanitizer immediately after. If sick contact SHSO/PM and leave Site immediately. • Disinfect work surfaces/areas with approved disinfectant you're responsible for (ex: desk, office doorknob, computer, etc.) at least once at the beginning of your shift and at least once at the end of your shift with either sanitizing wipes or disinfectant spray. • Phones should be operated hands free to extent feasible. Sanitize your phone on a regular basis. Disinfection should also take place whenever suspected contaminated material comes in contact with any work surfaces/areas. Wash hands or use hand sanitizer immediately after. • Avoid public spaces and going out to eat by bringing your own lunch to the Site. If performing work in high density urban areas, it is recommended all food must be consumed at or in your vehicle. Wash hands or use hand sanitizer before eating and immediately after.

Primary Infection Prevention Measures

- Wash your hands often with soap and water for at least 20 seconds.
    - If soap and water are not available, use an alcohol-based sanitizer that contains at least 60% ethanol or 70% isopropanol. Key times to wash hands include after blowing your nose, coughing or sneezing, after using the restroom, and before eating or preparing food.
- Do not touch your eyes, face, nose and mouth with unwashed hands.
- Cover your mouth and nose with a tissue when you cough or sneeze or use the inside of your elbow. Throw potentially contaminated items (e.g. used tissues) in the trash.
- Avoid close contact/secondary contact with people and potentially contaminated surfaces.
    - Apply appropriate social distance (6+ feet).
    - Stop handshaking/touching others and use caution when accessing public spaces.
- Clean and disinfect frequently touched surfaces daily. Commonly touched items can include but are not limited to tables, doorknobs, light switches, countertops, handles, desks, phones, keyboard, toilets, sinks and field equipment. If surfaces are dirty, they should be cleaned with soap and water prior to disinfection. If surface cannot be cleaned/disinfected, then wash hands or use sanitizer as soon as possible.

[1] Each Job or Operation consists of a set of tasks / steps. Be sure to list all the steps needed to perform job.

[2] A hazard is a potential danger. Break hazards into six types: Contact - victim is struck by or strikes an object;
Caught - victim is caught on, caught in or caught between objects; Fall - victim falls to ground or lower level (includes slips and trips); Exertion - excessive strain or stress / ergonomics / lifting techniques; Exposure - inhalation/skin hazards; Energy source – electricity, pressure, compression/tension.

[3] Using the first two columns as a guide, decide what actions or procedures are necessary to eliminate or minimize the risk. List the recommended safe operating procedures. Say exactly what needs to be done - such as "use two persons to lift". Avoid general statements such as, "be careful".

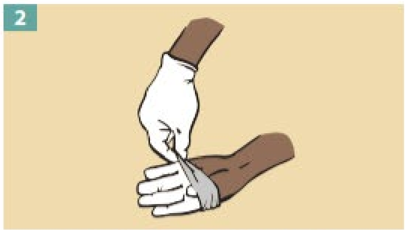
APPENDIX C

How to Remove Gloves

How to Remove Gloves

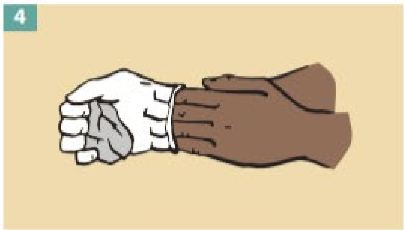
To protect yourself, use the following steps to take off gloves

Grasp the outside of one glove at the wrist.
Do not touch your bare skin.



Peel the glove away from your body,
pulling it inside out.

Hold the glove you just removed in
your gloved hand.



Peel off the second glove by putting your fingers
inside the glove at the top of your wrist.

Turn the second glove inside out while pulling
it away from your body, leaving the first glove
inside the second.

Dispose of the gloves safely. Do not reuse the gloves.

Clean your hands immediately after removing gloves.

APPENDIX D

Incident Investigation and Reporting Management Program

INCIDENT INVESTIGATION AND REPORTING MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	:	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	:	**01/19**
REVISION NUMBER	:	**4**

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Appendix B – Near Loss Form

Appendix C – Injury Illness Reporting Flow Chart

1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has instituted the following management program for reporting Environmental Health and Safety (EHS) incidents and near losses, investigation and correcting the causes of incidents, tracking incidents and corrective actions taken, and sharing the cause and corrective actions with Roux personnel. These practices and procedures establish a method to track progress and improvements to the company EHS performance.

2. SCOPE AND APPLICABILITY

These procedures apply to all Roux employees. Employees are required to follow these procedures for all incidents involving Roux personnel, or other personnel (e.g., subcontractors) working for Roux, regardless of the specific work activity or work location.

This program is intended, in part, to fulfill the Occupational Safety and Health Administration (OSHA) occupational injury and illness reporting and recording requirements cited in the Code of Federal Regulations (CFR) at 29 CFR 1904.

3. RESPONSIBILITIES

It shall be the responsibility of all Roux employees to report all incidents as soon as possible to the PM (or Administrative Manager for office-related incidents), SHSO, OHSM and OM, regardless of severity. Additionally, the following positions have specific responsibilities for implementing this specific SOP.

3.1 Corporate Health and Safety Manager (CHSM)

- The CHSM has the responsibility of ensuring that a system is in place for reporting, investigation, correction, and communicating of EHS incidents and near losses.
- The CHSM has the overall responsibility of implementing and communicating the contents of this program to Office Health and Safety Managers (OHSMs).
- The CHSM will review all incidents and corrective actions taken. The CHSM will provide a summary of serious incidents to the Board of Directors.
- The CHSM will communicate learnings from incidents and corrective actions taken to all personnel, through quarterly communications.
- The CHSM will periodically review and evaluate the effectiveness of this procedure.

3.2 Office Manager (OM)

- The OM will designate the individual to serve as the OHSM responsibility for ensuring that requirements in this procedure are met.
- The OM will ensure that sufficient resources are allocated to fulfill the requirements of this procedure.
- The OM will conduct final review of all incident reports prepared under this procedure.

3.3 Office Health and Safety Manager (OHSM)

- It is the responsibility of the OHSM to review draft incident reports and assist the OM in finalizing reports of all accidents, illnesses and incidents related to work activity, and to assist the SHSO when necessary.

- The OHSM may not approve a site-specific HASP unless the HASP includes incident reporting procedures and forms.
- The OHSM will suggest and implement corrective actions to prevent the same type of incident from re-occurring.
- The OHSM will keep all incident reports, corrective action taken, and follow-up forms on file. The OHSM will provide copies of all final reports and forms to the CHSM within one week of the incident. If a serious incident occurs, the CHSM will be notified as soon as possible.
- The occurrence of a serious incident will trigger an EHS audit by the OHSM.

3.4 Project Manager (PM)

- It shall be the PM's responsibility to promptly correct any deficiencies that were determined to cause or contribute to the incident investigated.
- If a site-specific HASP is not utilized, the PM must ensure that field personnel have copies of the Roux Accident Reporting and Investigation Forms.
- The PM has the responsibility of ensuring that the SHSO and other field personnel understand the need for timely incident reporting.
- In the event of an incident, the PM will determine the root cause of the incident with the assistance of the SHSO and/or OHSM. The PM should provide input as to corrective preventative measures.

3.5 Site Health and Safety Officer (SHSO)

- The SHSO shall provide the details of the incident to the OHSM, PM and OM. The OM or his delegate will provide additional notifications, such as, in the event of a work-related motor vehicle accident, to include Roux Legal.
- It is the SHSO's responsibility to immediately notify the OHSM and the PM when any incident occurs. Such notification should take place immediately following the completion of any emergency actions required by the HASP.
- The SHSO should provide input as to corrective preventative measures.
- The SHSO must ensure that corrective actions proposed by the OHSM or OM are carried out.

3.6 All Personnel

- All personnel are responsible for reporting and describing the details of any incident in which they are involved to the SHSO and PM. Such notification should take place immediately following the completion of any emergency actions required by the HASP and after the loss and before the scene is disturbed or vehicles moved.

4. PROCEDURE

4.1 Incident Investigation

On receiving a report of incident or near loss occurrence from a Roux employee, the SHSO or OHSM shall immediately investigate the circumstances and shall make appropriate recommendations to prevent recurrence. The Incident Report form can be found in **Appendix A**, and Near Loss form can be found in **Appendix B**. The OHSM may participate in the investigation of more serious accidents and incidents that occur on-site. The Corporate Health and Safety Manager (CHSM) shall also be immediately notified by telephone on occurrence of a serious accident or incident. At the CHSM's discretion, he may also participate in the investigation.

4.2 Incident Report

Details of the incident shall be documented using the Accident Report and Investigation Forms (Appendix A) within twenty-four (24) hours of the incident and shall be distributed to the SHSO, the OHSM, PM, OM and the CHSM. The CHSM will update OSHA Forms 301 and the 300 log when necessary.

Appendix A – Accident Report and Investigation Form

☐ **Roux Environmental Engineering and Geology, D.P.C.**
☐ **Roux Associates, Inc.** ☐ **Remedial Engineering, P.C.**

ACCIDENT REPORT

Brian Hobbs, Corporate Health and Safety Manager
Cell: (631) 807-0193; Office: (631) 630-2416

PART 1: ADMINISTRATIVE INFORMATION

Project #: ______________________________
Project Name: ______________________________
Project Location (street address/city/state):
____
____

Client Corporate Name / Contact / Address / Phone #:
____
____
____
____
____

Immediate Verbal Notifications Given To:

Corporate Health & Safety	☐Yes	☐No
Office Health & Safety	☐Yes	☐No
Office Manager	☐Yes	☐No
Project Principal	☐Yes	☐No
Project Manager	☐Yes	☐No
Client Contact	☐Yes	☐No

REPORT STATUS (time due):

☐ Initial (24 hr) ☐ Final (5-10 days)
Date: __________ Date: __________

Accident Report Delivered To:

Corporate Health & Safety	☐Yes	☐No
Office Health & Safety	☐Yes	☐No
Office Manager	☐Yes	☐No
Project Principal	☐Yes	☐No
Project Manager	☐Yes	☐No

REPORT TYPE: ☐ Loss ☐ Near Loss Estimated Costs: $ _____
____

OSHA CASE # Assigned by Corporate Health & Safety if Applicable:

Corporate Health & Safety Confirmed Final Accident Report
☐Yes ☐No

DATE OF INCIDENT: ______________

TIME INCIDENT OCCURRED: __________ ☐AM ☐PM

INCIDENT LOCATION – City, State, and Country (If outside U.S.A.)
____

INCIDENT TYPES: (Select most appropriate if Loss occurred.)
From lists below, please select the option that best categories the incident. When selecting an injury or illness, also indicate the severity level.

☐**INJURY** ☐**ILLNESS**

------------------------**Severity Level**---------------------------

☐Fatality
☐Restricted Work
☐First Aid
☐Lost Time
☐Medical Treatment

OTHER INCIDENT TYPES

☐Spill / Release
Material involved: ______________
Quantity (U.S. Gallons): __________
☐Misdirected Waste
☐Property Damage
☐Motor Vehicle
☐Consent Order
☐Exceedance
☐Fine / Penalty
☐NOV

ACTIVITY TYPE (Check most appropriate one.)

☐CAMP
☐Construction
☐Drilling
☐Driving
☐Excavation / Trenching
☐Gauging
☐O&M
☐Other Soil Work (e.g. Compaction)
☐Sampling
☐Site Walk/Inspection
☐Subsurface Clearance
☐Trucking
☐Waste Mgmt.
☐Work Area Prep.
☐Other

INJURY TYPE (Check all applicable.)

☐Abrasion
☐Amputation
☐Burn
☐Cold/Heat Stress
☐Inflammation
☐Laceration
☐Occupational Illness
☐Puncture
☐Rash
☐Repetitive Motion
☐Sprain/Strain
☐Other__________

BODY PART AFFECTED (Check all applicable.)

☐Respiratory
☐Neck
☐Chest
☐Abdomen
☐Groin
☐Back
☐Shoulder
☐Arm
☐Wrist
☐Hand/Fingers
☐Eye
☐Head
☐Face
☐Leg
☐Knee
☐Ankle
☐Foot/Toes
☐Other______

I. PERSON(S) DIRECTLY / INDIRECTLY INVOLVED IN INCIDENT (Attach additional information as necessary/applicable.)

Name/Phone # of Each Person Directly/Indirectly Involved in Incident:	Designate: Roux/Remedial Employee Roux/Remedial Subcontractor Client Employee Client Contractor Third Party	As applicable, Current Occupation; Yrs in Current Occupation; Current Position; and Yrs in Current Position:	As applicable, Employer Name; Address; and Phone #:	As applicable, Supervisor Name; and Phone #:
1)				
2)				

II. PERSONS INJURED IN INCIDENT (Attach additional information as necessary/applicable.)

Name/Phone # of Each Person Injured in Incident:	Designate: Roux/Remedial Employee Roux/Remedial Subcontractor Client Employee Client Contractor Third Party	As applicable, Current Occupation; Yrs in Current Occupation; Current Position; and Yrs in Current Position:	As applicable, Employer Name; Address; and Phone #:	As applicable, Supervisor Name; and Phone #:	Description of Injury:
1)					
2)					

III. PROPERTY DAMAGED IN INCIDENT (Attach additional information as necessary/applicable.)

Property Damaged:	Property Location:	Owner Name, Address & Phone #:	Description of Damage:	Estimated Cost:
1)				
2)				$

IV. WITNESSES TO INCIDENT (Attach additional information as necessary/applicable.)

Witness Name:	Address:	Phone #:
1)		
2)		

PART 2: WHAT HAPPENED AND INCIDENT DETAILS

PROVIDE FACTUAL DESCRIPTION OF INCIDENT (e.g., describe loss/near loss, injury, response / treatment).

I. AUTHORITIES/GOVERNMENTAL AGENCIES NOTIFIED (Attach additional information as necessary/applicable.)

Authority/Agency Notified:	Name/Phone #/Fax # of Person Notified:	Address of Person Notified:	Date & Time of Notification:	Exact Information Reported/Provided:

II. PUBLIC RESPONSES TO INCIDENT (if applicable)

Response/Inquiry By: (check one)	Entity Name:	Name/Phone # of Respondent/ Inquirer:	Address of Entity/Person:	Date & Time of Response/Inquiry:
☐Newspaper ☐Television ☐Community Group ☐Neighbors ☐Other ____________				

Describe Response/Inquiry:

Roux/Remedial Response:

(Check all that apply.) (Attach photos, drawings, etc. to help illustrate the incident.)

ATTACHED INFORMATION: ☐Photo ☐Sketches ☐Vehicle Acord Form ☐Police Report ☐Other

Name(s) of person(s) who prepared Initial and Final Report:	**Title(s):**	**Phone number(s):**

PART 3: INVESTIGATION TEAM ANALYSIS

Date Investigation Started (MM/DD/YYYY):

Factors, Root Causes, and Solution (FRCS): Complete FRCS form and answer all 7 factor questions. If answering NO to Factors 1 – 4 identify root cause(s) and explain why QIs) occurred. If answering YES to Factors 5 – 7 circle the root cause(s). Transfer the solutions guidance that addresses each root cause from the FRCS form to this form. Attach your completed FRCS Worksheet. If Factors 1-7 do not apply to the incident, write "External Cause" in the Factor column below and leave the remaining fields blank.

DESCRIPTION OF UNDESIRABLE BEHAVIOR/CONDITION

1.
2.

FACTOR(S) AND SOLUTION(S): HOW TO REDUCE POSSIBILITY OF INCIDENT RECURRING

Selection of factors and solutions reflects the analysis of investigation team and is not meant to be a legally binding conclusion as to the Root Cause and/or solution.

CAUSAL FACTOR/ BEHAVIOR/ CONDITION	ROOT CAUSE	SOLUTION(S) [Must Match Root Cause(s)]	PERSON RESPONSIBLE	AGREED DUE DATE	ACTUAL COMPLETION DATE

INVESTIGATION TEAM:

PRINT NAME	JOB POSITION	DATE	SIGNATURE

QUALITY REVIEW Correct root cause(s) identified? Do root cause(s) and solution(s) match? Are solution(s) feasible / maintainable?

Name: **Job Title:**

PART 4: Date Solutions were Implemented & Validated (Were Solutions Effective?)

Date	Solution	Verifier / Validator Name and Job Title	Details (of I & V performed)

Appendix B – Near Loss Form

HEALTH & SAFETY NEAR LOSS
ROUX REPORT FORM

☐ **Roux Environmental Engineering and Geology, D.P.C.**
☐ **Roux Associates, Inc.** ☐ **Remedial Engineering, P.C.**

(Check applicable company name)

PART 1: ADMINISTRATIVE INFORMATION

Office: ☐ New York ☐ Massachusetts ☐ New Jersey ☐ Illinois ☐ CA - Los Angeles ☐ CA - Oakland

Project Manager:	**Project Principal:**
Project Name:	**Project Location:**

PART 2: NEAR LOSS INCIDENT DETAILS

Date\Time Occurred (MM/DD/YYYY HH:MM):	**Date\Time Submitted** (MM/DD/YYYY HH:MM):

NEAR LOSS INCIDENT TYPE - What could have happened? - Select all that apply (1-7)

1. ☐ Fire / Explosion
2. ☐ Injury / Illness
3. ☐ Security (e.g., theft, trespassing, vandalism)
4. ☐ Environmental (Spill, permit exceedance, etc.)
5. ☐ Transportation of personnel (vehicle accident)
6. ☐ Property/Equipment Damage
7. ☐ Business Interruption

Event Leading to Potential Injury/Illness:

Job Task*:	**Equipment Involved*:**

WHAT HAPPENED? Do not include individuals' names. Ensure photos, sketches, etc. are not personally identifiable unless written consent has been obtained.

Summary (1-2 sentences. Provide brief description of the incident. Provide facts only, no speculation or opinion)**:**

Incident Details (Brief factual details of what, where, when; include photos, sketches, etc. as attachments)**:**

Immediate Corrective Actions Taken:

SERIOUS INJURY OR FATALITY (SIF): IF AN ACTUAL SIF, USE EXISTING ROUX ACCIDENT REPORTING FORM

Could this have resulted in a SIF? ☐ **Yes** ☐**No**

A potential SIF is defined as likely to have caused an injury resulting in significant physical body damage with probable long term and/or life altering complications.

INCIDENT INVOLVED:

Roux Employee: ☐ **Yes** ☐ **No** **Subcontractor Company Name:**

INVESTIGATION TEAM

NAME	**JOB TITLE**	**NAME**	**JOB TITLE**

PART 3: INCIDENT INVESTIGATION FINDINGS AND REPORT QUALITY REVIEW

Date Investigation Started (mm/dd/yyyy):

Factors, Root Causes, and Solution (FRCS): Complete FRCS form and answer all 7 factor questions. If answering NO to Factors 1 – 4 identify root cause(s) and explain why QIs) occurred. If answering YES to Factors 5 – 7 circle the root cause(s). Transfer the solutions guidance that addresses each root cause from the FRCS form to this form. Attach your completed FRCS Worksheet. If Factors 1-7 do not apply to the incident, write “External Cause” in the Factor column below and leave the remaining fields blank. Do not include individuals' names.

DESCRIPTION OF UNDESIRABLE BEHAVIOR/CONDITION

1.

2.

FACTOR(S) AND SOLUTION(S): HOW TO REDUCE POSSIBILITY OF INCIDENT RECURRING
Selection of factors and solutions reflects the analysis of investigation team and is not meant to be a legally binding conclusion as to the Root Cause and/or solution.

Behavior / Condition	Root Cause	Solution(s) (Must Match Root Cause)	Person Responsible for Completion	Completion Target Date	Completion Actual Date

QUALITY REVIEW Correct root cause(s) identified? Do root cause(s) and solution(s) match? Are solution(s) feasible / maintainable?

Name: **Job Title:**

PART 4: Date Solutions were Implemented & Validated (Were Solutions Effective?)

Date	Solution	Verifier / Validator Name and Job Title	**Details** (of I & V performed)

***JOB TASK - Select the most appropriate one** (primary job associated with incident-related work activity, avoid "Other" if possible)

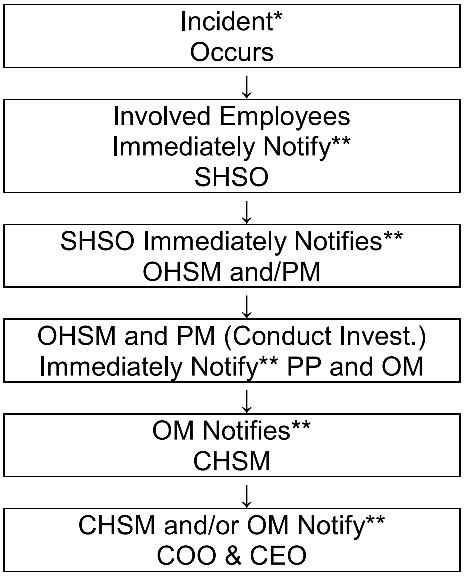
1. CAMP
2. Construction
3. Drilling
4. Driving
5. Excavation/Trenching
6. Gauging
7. O&M
8. Other Soil Work (e.g. Compaction)
9. Sampling
10. Site Walk/ Inspection
11. Subsurface Clearance
12. Trucking
13. Waste Management
14. Work Area Preparation
15. Other

***EQUIPMENT INVOLVED THAT CONTRIBUTED TO H&S NEAR LOSS - Select all that apply**

1. Air Stripper
2. API Separator
3. Automobile
4. Boom Material
5. Bulldozer
6. Cable
7. Carbon Drum / Vessel
8. Chain Block
9. Compressor, Air
10. Control Panel (local)
11. Crane (mobile)
12. Drill Rig
13. Drilling Equipment, Vacuum
14. Drum, Vertical
15. Dump Truck
16. Electric Heater
17. Electrical Power Supply
18. Engine, Combustion
19. Equipment Safety Grounding
20. Excavator / Power Shovel
21. Exclusion Zone Equipment
22 Fan / Blower
23 Fencing
24 Filter
25. Fire Extinguisher
26. Forklift
27. Front End Loader
28. Grader
29. Hammer
30. Knife
31. Non-Powered Equipment
32. Powered Equipment
33. Drill
34. Grinder
35. Hydraulic Torque Wrench
36. Powered Saw
37. Impact Wrench
38. Saw
39. Screwdriver
40. Shears
41. Shovel
42. Snip
43. Wrench
44. Hoist
45, Hook/Clamp/Buckle, etc.
46. Jack
47. Ladder, Extension
48. Ladder, Platform
49. Ladder, Step
50. Lock Out / Tag Out
51. Maintenance Tool, General
52. Manifold
53, Manlift/Basket/Cherry Picker
54. Motor, Electric
55. Oxidizer
56. Pallet
57. Piping
58. Piping, Hose
59. Piping, Injection/Mixing Point
60. Hydrojet
61. Centrifugal Pump
62. Diaphragm Pump
63. Reciprocating Pump
64. Regenerative Pump
65. Rotary Pump
66. Transfer Pump
67. Submersible Pump
68. Face Shield
69. Fall Protection
70. Gloves
71. Hard Hat / Helmet
72. Hearing Protection
73. Respiratory PPE (Chemical)
74. Respiratory PPE (Particulate)
75. Safety Glasses
76. Safety Goggles
77. Safety Shoes / Boots
78. Safety Vest / Clothing
79. Rope
80. Bailer
81. Geoprobe
82. Hand Auger
83. PID
84. Multi-Gas Meter
85. Sample Container
86. Split-Spoon Sampler
87. Sling
88. Snow Blower
89. Snow Plow
90. Space Heater
91. Air Sparging System
92. Carbon Treatment Sys
93. Chemical Oxidation S
94. Dual Phase Product Recovery System
95. Groundwater Pump and Treat System
96. POET System
97. Shed or Trailer
98. Vapor Extraction System
99. Vapor-Phase Treatment System
100. Other System, Type:____
101. Surge Tank
102. Underground Tank
103. Telemetry System
104. Testing Devices
105. Tractor Trailer
106. Truck, Flatbed
107. Truck, Pickup
108. Truck, Tank Truck
109. Truck, Vacuum
110. Safety Valve
111. Block Valve
112. Extraction Well
113. Monitoring Well
114. Recovery Well
115. Winch
116. Wire Rope
117. No Equipment Involved
118. MPT – Traffic Control Devices
118. Not in List (describe):____

Appendix C – Injury Illness Reporting Flow Chart

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



* Incident – any work or site-related occurrence that resulted in, or could potentially have resulted in, the need for medical care or in property damage (i.e., all injuries or illnesses, exposure to toxic materials or any other significant occurrence resulting in property damage or in a "near loss")

** Verbal Notification

Initial Incident Report (written) to SHSO, OHSM, OM and CHSM within 24 hours
Follow-up Report within one week.

☐ Roux Environmental Engineering and Geology, D.P.C.
☐ Roux Associates, Inc. ☐ Remedial Engineering, P.C.

ACCIDENT REPORT

Brian Hobbs, Corporate Health and Safety Manager
Cell: (631) 807-0193; Office: (631) 630-2416

PART 1: ADMINISTRATIVE INFORMATION

Project #: ______________________________
Project Name: ______________________________
Project Location (street address/city/state):
____
____

Client Corporate Name / Contact / Address / Phone #:
____
____
____
____
____

Immediate Verbal Notifications Given To:

Corporate Health & Safety	☐Yes	☐No
Office Health & Safety	☐Yes	☐No
Office Manager	☐Yes	☐No
Project Principal	☐Yes	☐No
Project Manager	☐Yes	☐No
Client Contact	☐Yes	☐No

REPORT STATUS (time due):

☐ Initial (24 hr) ☐ Final (5-10 days)
Date: ____________ Date: ____________

Accident Report Delivered To:

Corporate Health & Safety	☐Yes	☐No
Office Health & Safety	☐Yes	☐No
Office Manager	☐Yes	☐No
Project Principal	☐Yes	☐No
Project Manager	☐Yes	☐No

REPORT TYPE: ☐ Loss ☐ Near Loss Estimated Costs: $ _____
____

OSHA CASE # Assigned by Corporate Health & Safety if Applicable:

Corporate Health & Safety Confirmed Final Accident Report
☐Yes ☐No

DATE OF INCIDENT: ________________

TIME INCIDENT OCCURRED: ____________ ☐AM ☐PM

INCIDENT LOCATION – City, State, and Country (If outside U.S.A.)
____

INCIDENT TYPES: (Select most appropriate if Loss occurred.)
From lists below, please select the option that best categories the incident. When selecting an injury or illness, also indicate the severity level.

☐INJURY **☐ILLNESS**

-------------------------**Severity Level**----------------------------

☐Fatality
☐Restricted Work
☐First Aid
☐Lost Time
☐Medical Treatment

OTHER INCIDENT TYPES

☐Spill / Release
Material involved:________________
Quantity (U.S. Gallons): ____________

☐Misdirected Waste
☐Property Damage
☐Motor Vehicle
☐Consent Order
☐Exceedance
☐Fine / Penalty
☐NOV

ACTIVITY TYPE (Check most appropriate one.)

☐CAMP
☐Construction
☐Drilling
☐Driving
☐Excavation / Trenching
☐Gauging
☐O&M
☐Other Soil Work (e.g. Compaction)
☐Sampling
☐Site Walk/Inspection
☐Subsurface Clearance
☐Trucking
☐Waste Mgmt.
☐Work Area Prep.
☐Other

INJURY TYPE (Check all applicable.)

☐Abrasion
☐Amputation
☐Burn
☐Cold/Heat Stress
☐Inflammation
☐Laceration
☐Occupational Illness
☐Puncture
☐Rash
☐Repetitive Motion
☐Sprain/Strain
☐Other__________

BODY PART AFFECTED (Check all applicable.)

☐Respiratory
☐Neck
☐Chest
☐Abdomen
☐Groin
☐Back
☐Shoulder
☐Arm
☐Wrist
☐Hand/Fingers
☐Eye
☐Head
☐Face
☐Leg
☐Knee
☐Ankle
☐Foot/Toes
☐Other______

I. PERSON(S) DIRECTLY / INDIRECTLY INVOLVED IN INCIDENT (Attach additional information as necessary/applicable.)

Name/Phone # of Each Person Directly/Indirectly Involved in Incident:	Designate: Roux/Remedial Employee Roux/Remedial Subcontractor Client Employee Client Contractor Third Party	As applicable, Current Occupation; Yrs in Current Occupation; Current Position; and Yrs in Current Position:	As applicable, Employer Name; Address; and Phone #:	As applicable, Supervisor Name; and Phone #:
1)				
2)				

II. PERSONS INJURED IN INCIDENT (Attach additional information as necessary/applicable.)					
Name/Phone # of Each Person Injured in Incident:	Designate: Roux/Remedial Employee Roux/Remedial Subcontractor Client Employee Client Contractor Third Party	As applicable, Current Occupation; Yrs in Current Occupation; Current Position; and Yrs in Current Position:	As applicable, Employer Name; Address; and Phone #:	As applicable, Supervisor Name; and Phone #:	Description of Injury:
1)					
2)					

III. PROPERTY DAMAGED IN INCIDENT (Attach additional information as necessary/applicable.)				
Property Damaged:	Property Location:	Owner Name, Address & Phone #:	Description of Damage:	Estimated Cost:
1)				
2)				$

IV. WITNESSES TO INCIDENT (Attach additional information as necessary/applicable.)		
Witness Name:	Address:	Phone #:
1)		
2)		

PART 2: WHAT HAPPENED AND INCIDENT DETAILS

PROVIDE FACTUAL DESCRIPTION OF INCIDENT (e.g., describe loss/near loss, injury, response / treatment).

I. AUTHORITIES/GOVERNMENTAL AGENCIES NOTIFIED (Attach additional information as necessary/applicable.)				
Authority/Agency Notified:	Name/Phone #/Fax # of Person Notified:	Address of Person Notified:	Date & Time of Notification:	Exact Information Reported/Provided:

II. PUBLIC RESPONSES TO INCIDENT (if applicable)				
Response/Inquiry By: (check one)	Entity Name:	Name/Phone # of Respondent/ Inquirer:	Address of Entity/Person:	Date & Time of Response/Inquiry:
☐Newspaper ☐Television ☐Community Group ☐Neighbors ☐Other ____________				

Describe Response/Inquiry:

Roux/Remedial Response:

(Check all that apply.) (Attach photos, drawings, etc. to help illustrate the incident.)
ATTACHED INFORMATION: ☐Photo ☐Sketches ☐Vehicle Acord Form ☐Police Report ☐Other

Name(s) of person(s) who prepared Initial and Final Report:	**Title(s):**	**Phone number(s):**

PART 3: INVESTIGATION TEAM ANALYSIS

Date Investigation Started (MM/DD/YYYY):

Factors, Root Causes, and Solution (FRCS): Complete FRCS form and answer all 7 factor questions. If answering NO to Factors 1 – 4 identify root cause(s) and explain why QIs) occurred. If answering YES to Factors 5 – 7 circle the root cause(s). Transfer the solutions guidance that addresses each root cause from the FRCS form to this form. Attach your completed FRCS Worksheet. If Factors 1-7 do not apply to the incident, write "External Cause" in the Factor column below and leave the remaining fields blank.

DESCRIPTION OF UNDESIRABLE BEHAVIOR/CONDITION

1.
2.

FACTOR(S) AND SOLUTION(S): HOW TO REDUCE POSSIBILITY OF INCIDENT RECURRING
Selection of factors and solutions reflects the analysis of investigation team and is not meant to be a legally binding conclusion as to the Root Cause and/or solution.

CAUSAL FACTOR/ BEHAVIOR/ CONDITION	ROOT CAUSE	SOLUTION(S) [Must Match Root Cause(s)]	PERSON RESPONSIBLE	AGREED DUE DATE	ACTUAL COMPLETION DATE

INVESTIGATION TEAM:

PRINT NAME	JOB POSITION	DATE	SIGNATURE

QUALITY REVIEW Correct root cause(s) identified? Do root cause(s) and solution(s) match? Are solution(s) feasible / maintainable?

Name: **Job Title:**

PART 4: Date Solutions were Implemented & Validated (Were Solutions Effective?)

Date	Solution	Verifier / Validator Name and Job Title	**Details** (of I & V performed)

APPENDIX E

Personal Protective Equipment Management Program

PERSONAL PROTECTIVE EQUIPMENT MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER : **Brian Hobbs, CIH, CSP**

EFFECTIVE DATE : **01/19**

REVISION NUMBER : **4**

TABLE OF CONTENTS

1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has instituted the following program to establish guidelines for the selection of personal protective equipment (PPE) for use by Roux personnel performing field activities in hazardous environments. PPE is not meant to be a substitute for engineering, work practice, and/or administrative controls, but PPE should be used in conjunction with these controls to protect the employees in the work place. Clothing, body coverings, and other accessories designed to prevent worker exposure to workplace hazards are all types of PPE. To ensure adequate PPE employee-owned PPE is evaluated on a case-by-case basis to insure its adequacy, maintenance and sanitation.

2. SCOPE AND APPLICABILITY

These guidelines apply to all PPE selection decisions to be made in implementing the Roux program. The foundations for this program are the numerous Occupational Health and Safety Administration (OSHA) standards related to PPE cited in 29 CFR 1910 Subpart I, 29 CFR 1926 Subpart E, and the hazardous environment work employee protection requirements under the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 and 1926.65. To ensure hazard assessments are documented the levels of protection, types of protection and tasks requiring protection are covered in site-specific Health and Safety Plans (HASPs) and Job Safety Analyses (JSAs).

3. PROCEDURES

Due to the varied nature of site activities and the different potential hazards associated with different sites, several aspects must be considered when selecting PPE. The following text describes PPE selection logic and provides guidelines and requirements for the appropriate selection and use of PPE.

3.1 Introduction

To harm the body, chemicals must first gain entrance. The intact skin and the respiratory tract are usually the first body tissues attacked by chemical contaminants. These tissues provide barriers to some chemicals but in many cases, are damaged themselves or are highly permeable by certain chemical compounds. Personal protective equipment therefore is used to minimize or eliminate chemical compounds coming into contact with these first barrier tissues.

The proper selection of equipment is important in preventing exposures. The PM making the selection will have to take several factors into consideration. The level of protection, type and kind of equipment selected depends on the hazardous conditions and in some cases cost, availability, compatibility with other equipment, and performance. An accurate assessment of all these factors must be made before work can be safely carried out.

3.2 Types of PPE

The type and selection of PPE must meet certain general criteria and requirements as required under OSHA 29 CFR 1910.132 and 1926.95. In addition to these general requirements, specific requirements and specifications exist for some types of PPE that form the basis of the protective clothing scheme. Following is a list of the common types of specific PPE and the specific requirements for the PPE type, where applicable:

1. Hard Hats - Regulated by 29 CFR 1910.135 and 1926.100; and, specified in ANSI Z89.1.

2. Face Shields and Safety Glasses - Regulated by 29 CFR 1910.133 and 1926.102; and, specified in ANSI Z87.1.
3. Respiratory Protection - Regulated by 29 CFR 1910.134 and 1926.103.
4. Hand Protection - Not specifically regulated.
5. Foot Protection - Regulated by 29 CFR 1910.136 and 1926.96; and, specified in ANSI Z41.1.
6. Protective Clothing (e.g., fully encapsulated suits, aprons) - Not specifically regulated.

3.3 Protective Clothing Selection Criteria

3.3.1 Chemicals Present

The most important factor in selecting PPE is the determination of what chemicals the employee may be exposed to. On field investigations, the number of chemicals may range from a few to several hundred. The exact chemicals or group of chemicals present at the site (certain groups tend to require similar protection) can be determined by collecting and analyzing samples of the air, soil, water, or other site media. When data are lacking, research into the materials used or stored at the site can be used to infer chemicals possibly on the site.

Once the known or suspected chemicals have been identified, and taking into consideration the type of work to be performed, the most appropriate clothing shall be selected.

Protective garments are made of several different substances for protection against specific chemicals. There is no universal protective material. All will decompose, be permeated by, or otherwise fail to protect under given circumstances. Fortunately, most manufacturers make guides to the use of their products (i.e., Dupont's Tyvek™ Permeation Guide). These guides are usually for gloves and coveralls and typically provide information regarding chemical degradation rates (failure of the material to maintain structural integrity when in contact with the chemical), and may provide information on the permeation rate (whether or not the material allows the chemical to pass through). When permeation tables are available, they shall be used in conjunction with degradation tables to determine the most appropriate protective material.

During most site work, chemicals are usually in mixed combinations and the protective materials are not in continuous contact with pure chemicals for long periods of time; therefore, the selected material may be adequate for the particular chemical and type of work being performed, yet not the "best" protecting material for all site chemicals and activities. Selection shall depend upon the most hazardous chemicals based on their hazards and concentrations. Sometimes layering, using several different layers of protective materials, affords the best protection.

3.3.2 Concentration of the Chemical(s)

One of the major criteria for selecting protective material is the concentration of the chemical(s) in air, liquid, and/or solid state. Airborne and liquid chemical concentrations should be compared to the OSHA standards and/or American Conference of Governmental Industrial Hygienists (ACGIH) and National Institute for Occupational Safety and Health (NIOSH) guidelines to determine the level of skin or other absorptive surface (e.g., eyes) protection needed. While these standards are not designed specifically for skin exposed directly to the liquid, they may provide skin designations indicative of chemicals known to have significant skin or dermal absorption effects. For example, airborne levels of PCB on-site may be low because it is not very volatile, so the inhalation hazard may be minimal; however, PCB-containing liquid coming in direct contact with the skin may cause overexposure. Thus, PCB has been assigned a skin designation in both the OSHA and ACGIH exposure limit tables.

3.3.3 Physical State

The characteristics of a chemical may range from nontoxic to extremely toxic depending on its physical state. Inorganic lead in soil would not be considered toxic to site personnel, unless it became airborne, since it is generally not absorbed through the intact skin. Organic lead in a liquid could be readily absorbed. Soil is frequently contaminated with hazardous materials. Concentrations will vary from a few parts per million to nearly one hundred percent. The degree of hazard is dependent on the type of soil and concentration of the chemical. Generally speaking, "dry" soils do not cause a hazard to site personnel if they take minimal precautions such as wearing some type of lightweight gloves.

3.3.4 Length of Exposure

The length of time a material is exposed to a chemical increases the probability of breakthrough. Determinations of actual breakthrough times for short-term exposures indicate that several different materials can be used which would be considered inadequate under long-term exposures. It should be kept in mind that during testing, a pure (100% composition) liquid is usually placed in direct contact with the material producing a worst-case situation.

3.3.5 Abrasion

When selecting protective clothing, the job the employee is engaged in must be taken into consideration. Persons moving drums or performing other manual tasks may require added protection for their hands, lower chest and thighs. The use of leather gloves and a heavy apron over the other normal protective clothing will help prevent damage to the normal PPE and thus reduce worker exposures.

3.3.6 Dexterity

Although protection from skin and inhalation hazards is the primary concern when selecting PPE, the ability to perform the assigned task must be maintained. For example, personnel cannot be expected to perform work that requires fine dexterity if they must wear a thick glove. Therefore, the PPE selection process must consider the task being performed and provide PPE alternatives or techniques that allow dexterity to be maintained while still protecting the worker (e.g., wearing tight latex gloves over more bulky hand protection to increase dexterity).

3.3.7 Ability to Decontaminate

If disposable clothing cannot be used, the ability to decontaminate the materials selected must be taken into consideration. Once a chemical contacts the material, it must be cleaned before it can be reused. If the chemical has completely permeated the material, it is unlikely that the clothing can be adequately decontaminated and the material should be discarded.

3.3.8 Climactic Conditions

The human body works best with few restraints from clothing. Protective clothing adds a burden by adding weight and restricting movement as well as preventing the natural cooling process. In severe situations, a modified work program must be used.

Some materials act differently when they are very hot and very cold. For example, PVC becomes almost brittle in very cold temperatures. If there are any questions about the stability of the protective materials under different conditions, the manufacturer should be contacted.

3.3.9 Work Load

Like climactic conditions, the type of work activity may affect work duration and the ability or personnel to perform certain tasks. Similarly, the amount of protective materials a person wears will affect their ability to perform certain tasks. For example, a person in a total encapsulating suit, even at 72 °F, cannot work for more than a short period of time without requiring a break.

The work schedule should be adjusted to maintain the health of the employees. Special consideration should be given to the selection of clothing that both protects and adds the least burden when personnel are required to perform strenuous tasks. Excessive bodily stress frequently represents the most significant hazard encountered during field work.

3.4 Types of Protective Materials

1. Cellulose or Paper
2. Natural and Synthetic Fibers
   a. Tyvek™
   b. Nomex™
3. Elastomers
   a. Polyethylene
   b. Saran
   c. Polyvinyl Chloride (PVC)
   d. Neoprene
   e. Butyl Rubber
   f. Viton

3.5 Protection Levels

3.5.1 Level A Protection

Level A protection (a fully encapsulated suit) is used when skin hazards exist or when there is no known data that positively rule out skin and other absorption hazards. Since Level A protection is extremely physiologically and psychologically stressful, the decision to use this protection must be carefully considered. At no time will Level A work be performed without the consent of the OM. The following conditions suggest a need for Level A protection:

- confined facilities where probability of skin contact is high;
- sites containing known skin hazards;
- sites with no established history to rule out skin and other absorption hazards;
- atmosphere immediately dangerous to life and health (IDLH) through the skin absorption route;
- site exhibiting signs of acute mammalian toxicity (e.g., dead animals, illnesses associated with past entry into site by humans);

- sites at which sealed drums of unknown materials must be opened;
- total atmospheric readings on the Photoionization Detector (PID), Flame Ionization Detector (FID), and similar instruments indicate 500 to 1,000 ppm of unidentified substances; and
- extremely hazardous substances (e.g., cyanide compounds, concentrated pesticides, Department of Transportation Poison "A" materials, suspected carcinogens and infectious substances) are known or suspected to be present and skin contact is possible.

The following items constitute Level A protection:

- open circuit, pressure-demand self-contained breathing apparatus (SCBA);
- totally encapsulated suit;
- gloves, inner (surgical type);
- gloves, outer;
- chemical protective;
- boots, chemical protective, steel toe and shank;
- radiation detector (if applicable); and
- communications.

3.5.2 Level B Protection

Level B protection is utilized when the highest level of respiratory protection is needed but hazardous material exposure to the few unprotected areas of the body is unlikely.

The following conditions suggest a need for Level B protection:

- the type and atmospheric concentration of toxic substances have been identified and they require the highest level of respiratory protection;
- IDLH atmospheres where the substance or concentration in the air does not present a severe skin hazard;
- the type and concentrations of toxic substances do not meet the selection criteria permitting the use of air purifying respirators; and
- it is highly unlikely that the work being done will generate high concentrations of vapors, gases or particulates, or splashes of materials that will affect the skin of personnel.

Personal protective equipment for Level B includes:

- open circuit, pressure-demand SCBA;
- chemical protective clothing:
- overalls and long-sleeve jacket; or
- coveralls;
- gloves, inner (surgical type); gloves, outer, chemical protective;
- boots, chemical protective, steel toe and shank; and
- communications optional.

3.5.3 Level C Protection

Level C protection is utilized when both skin and respiratory hazards are well defined and the criteria for the use of negative pressure respirators have been fulfilled (i.e., known contaminants and contaminant concentrations, acceptable oxygen levels, approved filter/cartridge available, known cartridge service life, etc.). Level C protection may require carrying an emergency escape respirator during certain initial entry and site reconnaissance situations, or when applicable thereafter.

Personal protective equipment for Level C typically includes:

- full facepiece air-purifying respirator;
- emergency escape respirator (optional);
- chemical protective clothing:
  - overalls and long-sleeved jacket; or
  - coveralls;
- gloves, inner (surgical type);
- gloves, outer, chemical protective; and
- boots, chemical protective, steel toe and shank.

3.5.4 Level D Protection

Level D is the basic work uniform. Personal protective equipment for Level D includes:

- coveralls;
- safety boots/shoes;
- eye protection;
- hand protection;
- reflective traffic safety vest (mandatory for traffic areas or railyard);
- hard hat (with face shield is optional); and
- emergency escape respirator is optional.

3.5.5 Level E Protection

Level E protection is used when radioactivity above 10 mr/hr is detected at the site. Personal protective equipment for Level E includes:

- coveralls;
- air purifying respirator;
- time limits on exposure;
- appropriate dermal protection for the type of radiation present; and
- radiation dosage monitoring.

3.5.6 Additional Considerations

Field work will contain a variety of situations due to chemicals in various concentrations and combinations. These situations may be partially ameliorated by following the work practices listed below:

1. Some sort of foot protection is needed on a site. If the ground to be worked on is contaminated with liquid and it is necessary to walk in the chemicals, some sort of protective "booties" can be worn over the boots. This cuts down on decontamination requirements. They are designed with soles to help prevent them from slipping around. If non-liquids are to be encountered, a Tyvek™ bootie could be used. If the ground contains any sharp objects, the advantage of booties is questionable. Boots should be worn with either cotton or wool socks to help absorb the perspiration.
2. If the site situation requires the use of hard hats, chin straps should be used if a person will be stooping over where his/her hat may fall off. Respirator straps should not be placed over the hard hats. This will affect the fit of the respirator.

   Some types of protective materials conduct heat and cold readily. In cold conditions, natural material clothing should be worn under the protective clothing. Protective clothing should be removed prior to allowing a person "to get warm". Applying heat, such as a space heater, to the outside of the protective clothing may drive the contaminants through. In hot weather, under clothing will absorb sweat. It is recommended that workers use all cotton undergarments.
3. Body protection should be worn and taped to prevent anything from running into the top of the boot. Gloves should be worn and taped to prevent substances from entering the top of the glove. Duct tape is preferred, but masking tape can be used. When aprons are used, they should be taped across the back for added protection. However, this should be done in such a way that the person has mobility.
4. Atmospheric conditions such as precipitation, temperature, wind direction, wind velocity, and pressure determine the behavior of contaminants in air or the potential for volatile material getting into the air. These parameters should be considered in determining the need for and the level of protection.
5. A program must be established for periodic monitoring of the air during site operations. Without an air monitoring program, any changes would go undetected and might jeopardize response personnel. Monitoring can be done with various types of air pumps and filtering devices followed by analysis of the filtration media; personnel dosimeters; and periodic walk-throughs by personnel carrying real-time survey instruments.
6. For operations in the exclusion zone, different levels of protection may be selected, and various types of chemical-resistant clothing may be worn. This selection should be based on the job function, reason for being in the area, and the potential for skin contact with, or inhalation of, the chemicals present.
7. Escape masks must be readily available when levels of respiratory protection do not include a SCBA and the possibility of an IDLH atmosphere exists. Their use can be made on a case-by-case basis. Escape masks could be strategically located at the site in areas that have higher possibilities of vapors, gases or particulates.

APPENDIX F

New York State Department of Health Generic Community Air Monitoring Plan

New York State Department of Health (NYSDOH)
Generic Community Air Monitoring Plan (CAMP)

Overview

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

The generic CAMP presented below will be sufficient to cover many, if not most sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical-specific monitoring with appropriately sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

> **Continuous monitoring** will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.
>
> **Periodic monitoring** for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required 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.

VOC Monitoring, Response Levels, and Actions

VOCs must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.
2. 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 must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can 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.
3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.
4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must 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.

1. 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 must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.
2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can 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.
3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

APPENDIX G

Subsurface Utility Clearance Management Program

SUBSURFACE UTILITY CLEARANCE MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	:	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	:	**01/19**
REVISION NUMBER	:	**2**

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APPENDICES

1. PURPOSE

Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, “Roux”) has instituted the following program for completing proper utility mark-outs and for conducting subsurface clearance activities. This establishes a method to ensure, to the greatest extent possible, that utilities have been identified and contact and/or damage to underground utilities and other subsurface structures will be avoided.

2. SCOPE AND APPLICABILITY

The Subsurface Utility Clearance Management Program applies to all Roux employees, its contractors and subcontractors. Employees are expected to follow this program for all intrusive work involving Roux or other personnel (e.g., contractors/subcontractors) working for Roux unless the client’s requirements are more stringent. Deviation from the program regardless of the specific work activity or work location must be pre-approved based on client’s site knowledge, site experience and client’s willingness for the use of this program. Any and all exceptions shall be documented and pre-approved by the Project Principal and the Office Manager.

3. PROCEDURES

3.1 Before Intrusive Activities

During the project kick-off meeting for intrusive activities the PM will review the Roux Subsurface Utility Clearance Checklist and Utility Verification (Appendix C) / Site Walkthrough Record (Appendix D) and the below bullet points with the project field team:

(Please note that these are intended as general reminders only and should not be solely relied upon.)

- Ensure the Mark-out / Stake-out Request Information Sheet (or one-call report) is complete and accurate for the site including address and cross streets and review for missing utilities. (Note: utility mark-out organizations do not have contracts with all utilities and it is often necessary to contact certain utilities separately such as the local water and sewer authorities).
- Have written confirmation prior to mobilizing to the site that the firm or Roux personnel performing the intrusive activity has correctly completed the mark-out notification process including requesting mark-outs, waiting for mark-outs to be applied to ground surfaces at the site, and receiving written confirmation of findings (via fax or email) from utility operators for all known or suspected utilities in the proposed area of intrusive activity, and provided utility owner written confirmation to Roux personnel for review and project files documentation.
- Do not begin any intrusive activity until all utilities mark-out has been completed (i.e., did all utilities mark-out the site?) and any unresolved mark-out issues are finalized. Perform a site walk to review the existing utilities and determine if said utilities have been located by the utility locators.

  (Note: The Tolerance Zone is defined as two feet plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct banks and other non-cylindrical utilities) of a utility and two feet from the outside edge of any subsurface structure.)
- Install Pre-Clearance exploratory test holes (e.g., hand-dug test holes or other soft digging techniques) for the first 5-ft below land surface (BLS) at each location prior to conducting mechanized intrusive activities. The size of the pre-clearance exploratory test hole should be at a minimum twice the diameter of any downhole tool or boring device. (Note: Pre-Clearance exploratory test holes should be defined in the SOW/proposal provided to the client to prevent project delays and to allow adequate time for PM and PP to evaluate alternative approaches for the project. Alternative approaches will need to be pre-approved by the OM.

- For excavations, all utilities need to be marked and then exposed by hand following the protocols in this program. Pre-clearing for excavations may be performed by the "moat" technique (i.e., soft digging around the perimeter). In these cases, dig in small lifts (<12" for first 5 feet) using a dedicated spotter.) For Tolerance Zone work, unless otherwise agreed upon with the Utility Operator, work within the tolerance zone requires verification by means of hand-dug test holes performed to expose the utility. Once structures have been verified a minimum clearance of two feet must be maintained between the utility and any powered equipment.
- In addition, the following activities should be conducted:
    - Review the work scope to be performed with the site owner/tenant to determine if it may impact any utilities;
    - Attempt to procure any utility maps or historic drawings of subsurface conditions of the site;
    - **Determine the need for utility owner companies to be contacted or to have their representatives on site**;
    - Where mark-outs terminate at the property boundary, consider the use of private utility locating / GPR / geophysical-type services which may be helpful in locating utilities. Use of private utility locating firms, however, does not eliminate the legal requirement for the Excavator firm to submit a request for Public Utility Mark-outs. Also, the information provided by the service may be inaccurate and unable to locate subsurface utilities and structures in urban areas, landfills, urban fill areas and below reinforced slabs, etc. They should not be relied upon as the only means of performing utility clearance;
    - Documented description of the dig site which is included in the projects Health and Safety Plan (HASP) and one call report will be maintained in the field and distributed amongst Roux personnel its contractors and subcontractors; and
    - Documentation of the actual placement of mark outs in the field shall be collected using dated pictures, videos and/or sketches with distance from markings to fixed objects. All documentation shall be maintained within the project file.

3.2 During Intrusive Activities

The PM, field team lead or personnel performing oversight is to:

- Ensure the mark-out remains valid. (In certain states there are limits regarding the duration of time after the mark-out was applied to the ground surface work can be started or interrupted.) Additionally, the mark-outs must be maintained, documented, and in many cases refreshed periodically to be considered valid, this will be accomplished through calls to the one call center.
- Ensure intrusive activities are only performed within the safe boundaries of the mark-out as detailed in the One-Call Report.
- Halt all work if intrusive activities have resulted in discovery of an unmarked utility. Roux personnel shall notify the facility owner/operator and the one call center. All incidents such as this will be reported as per Roux Incident Investigation and Reporting Management Program.
- Halt all work if intrusive activities must take place outside of the safe boundaries of a mark-out and only proceed after new mark-outs are performed.
- Halt the intrusive activities and immediately consult with the PP if an unmarked utility is encountered.
- Completing any subsurface utility clearance incident reports that are necessary.

- If a utility cannot be found as marked Roux personnel shall notify the facility owner/operator directly or through the one call center. Following notification, the excavation may continue, unless otherwise specified in state law.
- Contractors/subcontractors must contact the one-call center to refresh the ticket when the excavation continues past the life of the ticket. Ticket life shall be dictated by state law however at a maximum ticket life shall not exceed 20 working days.

3.3 Stop Work Authority

Each Roux employee has Stop Work Authority which he or she will execute upon determination of any imminent safety hazard, emergency situation, or other potentially dangerous situation, such as hazardous weather conditions. This Stop Work Authority includes subsurface clearance issues such as the adequacy of a mark-out or identification during intrusive operations of an unexpected underground utility. Authorization to proceed with work will be issued by the PM/PP after such action is reviewed and resolved. The PM will initiate and execute all management notifications and contact with emergency facilities and personnel when this action is appropriate.

Appendix A - Definitions

Intrusive Work Activities	All activities such as digging or scraping the surface, including but not limited to, excavation, test pitting or trenching, soil vapor sampling or the installation of soil borings, soil vapor monitoring points and wells, or monitoring wells, and drilling within the basement slab of a recently demolished building.
Mark-out / Stake Out	The process of contracting with a competent and qualified company to confirm the presence or absence of underground utilities and structures. This process will clearly mark-out and delineate utilities that are identified so that intrusive work activities can be performed without causing disturbance or damage to the subsurface utilities and structures. After utility mark-outs are completed the soft digging will be completed prior to intrusive work.
Tolerance Zone	Defined as two feet on either side of the designated centerline of an identified utility, plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct backs and other non-cylindrical utilities) of that utility and two feet from the outside edge of any subsurface structure.
Structure	For the purpose of this program a structure is defined as any underground feature that may a present potential source(s) of energy such as, but not limited to, utility vaults, bunkers, piping, electrical boxes, wires, conduits, culverts, utility lines, underground tanks and ducts.
Soft Digging	The safest way to remove material from unknown obstructions or services is by using tools such as a vactor or air knife, non-mechanical tools, or hand tools. The methods are clean and non-evasive and used for uncovering and exposing buried services, excavating and for providing a quick method of soil removal from sensitive areas.
Verification	Exploratory test-hole dug with hand tools within the Tolerance Zone to expose and verify the location, type, size, direction-of-run and depth of a utility or subsurface structure. Vacuum excavation (soft dig) methods can further facilitate exposure of a subsurface utility and accurately provide its location and identification prior to intrusive work approaching the Tolerance Zone.

Appendix B - Example of Completed One Call Report

Example Completed One-Call Report

New York 811

Send To: C_EMAIL Seq No: 744

Ticket No: 133451007 ROUTINE

Start Date: 12/16/13 Time: 7:00 AM Lead Time: 20

State: NY County: QUEENS Place: QUEENS
Dig Street: 46TH AVE Address:
Nearest Intersecting Street: VERNON BLVD
Second Intersecting Street: 11TH ST

Type of Work: SOIL BORINGS
Type of Equipment: GEOPROBE
Work Being Done For: ROUX

In Street: X On Sidewalk: X Private Property: Other:
On Property Location if Private: Front: Rear: Side:

Location of Work: MARK THE ENTIRE NORTH SIDE OF THE STREET AND SIDEWALK OF:
46TH AVE BETWEEN VERNON BLVD AND 11TH STREET

Remarks:

Nad: Lat: Lon: Zone:
ExCoord NW Lat: 40.7475399 Lon: -73.9534811 SE Lat: 40.7457406 Lon: -73.9493680

Company : ZEBRA ENVIROMENTAL Best Time: 6AM-5PM
Contact Name: DAVID VINES Phone: (516)596-6300
Field Contact: DAVID VINES Phone: (516)596-6300
Caller Address: 30 N PROSPECT AVE Fax Phone: (516)596-4422
LYNBROOK, NY 11563
Email Address: david@zebraenv.com

Additional Operators Notified:

ATTNY01	AT&T CORPORATION	(903)753-3145
CEQ	CONSOLIDATED EDISON CO. OF N.Y	(800)778-9140
MCINY01	MCI	(800)289-3427
PANYNJ01	PORT AUTHORITY OF NY & NJ	(201)595-4841
VZQ	VERIZON COMMUNICATIONS	(516)297-1602

Link to Map for C_EMAIL: http://ny.itic.occinc.com/XGMZ-DF2-L23-YAY

Original Call Date: 12/11/13 Time: 1:15 PM Op: webusr
IMPORTANT NOTE: YOU MUST CONTACT ANY OTHER UTILITIES DIRECTLY

Appendix C - Roux Subsurface Utility Clearance Checklist

Roux Subsurface Utility Clearance Checklist ***Date of Revision – 12/3/14***

Work site set-up and work execution

ACTIVITY	Yes	No	N/A	COMMENTS INCLUDING JUSTIFICATION IF RESPONSE IS NO OR NOT APPLICABLE
Daily site safety meeting conducted, SPSAs performed, JSAs reviewed, appropriate work permits obtained.				
HASP is available and reviewed by site workers / visitors.				
Subsurface Utility Clearance Procedure has been reviewed with all site workers.				
Work area secured; traffic control established as needed. Emergency shut-off switch located. Fire extinguishers / other safety equipment available as needed.				
Utility mark-outs (public / private) clear and visible. Provide Excavator’s Stake-Out Reference Number / Request Date / Time.				
Tolerance zone work identified.				
Work execution plan reviewed and adhered to (ground disturbance methods, clearance depths, any special utility protection requirements, or any other execution requirements; especially for Tolerance Zone work).				
Verbal endorsement received from Roux PM for any required field deviations to work execution plan.				

Key reminders for execution:

The Subsurface Utility Clearance Protocol should be referenced to determine all requirements while executing subsurface work. The bullet points below are intended as general reminders only and should not be solely relied upon.

- Tolerance zone is defined as two feet plus half of the diameter or half of the greatest dimension (for elliptical sewers, duct banks and other non-cylindrical utilities) of a utility and two feet from the outside of any subsurface structure.
- Install Pre-Clearance exploratory test holes (e.g., hand-dug test holes or vacuum excavation) must be performed for the first five feet below land surface (BLS) at each location prior to conducting mechanized intrusive activities. The size of the pre-clearance exploratory test hole should be at a minimum twice the diameter of any downhole tool or boring device. (Note: Pre-clearance exploratory test holes should be defined in the SOW/proposal provided to the client to prevent project delays and to allow adequate time for PM and PP to evaluate alternative approaches for the project. Alternate approaches will need to be pre-approved by the OM.
- For excavations, all utilities need to be marked and then exposed by hand following the protocols in this program. Pre-clearing for excavations may be performed by the “moat” technique (i.e., soft

digging around the perimeter). In these cases, dig in small lifts (<12" for first five feet) using a dedicated spotter.) For Tolerance Zone work, unless otherwise agreed upon with the Utility Operator, work within the tolerance zone requires verification by means of hand-dug test holes to expose the utility. Once structures have been verified a minimum clearance of two feet must be maintained between the utility and any powered equipment.

Appendix D - Utility Verification/Site Walkthrough Record

Employee Name:____

Date: ____

Instructions: For each utility suspected at the job site, indicate location on the job site, approximate burial depth, and means of detecting the utility. Leave blank if that utility is not believed to be present.

Utility	Description of Utility Location Identified Onsite	Approx. Depth (bls)	Method / Instrumentation used to determine Utility Location	Utility Owner Response (Date/Time)	Mark Out Indicates (Clear / Conflict)
Electrical Lines					
Gas Lines					
Pipelines					
Steam Lines					
Water Lines					
Sanitary and Stormwater Sewer lines					
Pressured Air-Lines					
Tank Vent Lines					
Fiber Optic Lines					
Underground Storage Tanks					
Phone Lines/ Other					

* bls - below land surface

Site Sketch Showing Utilities:

Color Code

- ELECTRIC
- Gas-oil Steam
- Communications CATV
- WATER
- Reclaimed Water
- SEWER
- Temp. Survey Markings
- Proposed Excavation

Other Comments / Findings:

Completed by: ______________________________

Signature: ______________________________ Date: ____________

APPENDIX H

Heavy Equipment Exclusion Zone Policy

HEAVY EQUIPMENT EXCLUSION ZONE MANAGEMENT PROGRAM

CORPORATE HEALTH AND SAFETY MANAGER	:	**Brian Hobbs, CIH, CSP**
EFFECTIVE DATE	:	**01/2019**
REVISION NUMBER	:	**1**

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1. PURPOSE

The purpose of the Exclusion Zone Management Program is to establish the minimum clearance distance that must be maintained between workers and heavy equipment while equipment is in operation (i.e., engaged or moving). The intent is to have no personnel or equipment entering the Exclusion Zone while the equipment is in operation or moving to ensure that Roux and Subcontractor employees are not unnecessarily exposed to the hazards of the equipment.

2. SCOPE AND APPLICABILITY

This Management Program applies to all Roux Associates, Inc. and its affiliated companies, Roux Environmental Engineering and Geology, D.P.C, and Remedial Engineering (collectively, "Roux") employees and their subcontractors who are performing field work and are potentially exposed to heavy equipment. For the purpose of this program, heavy equipment includes, but is not necessarily limited to: excavation equipment, drill rigs, vacuum trucks, forklifts, lull telehandlers, man lifts, bobcats, delivery trucks, etc.

3. PROCEDURES

As specified in the following sections of this Program, an Exclusion Zones must be established and maintained during activities involving the movement/operation of heavy equipment. The Exclusion Zone requirements apply to all personnel on the site but are primarily focused on those personnel who are required to be working in the vicinity of the equipment. The exclusion zone is in effect when heavy equipment is moving or engaged (ex. movement of an arm or bucket of an excavator, rotation of an auger, lifting of a load with a forklift, raising/lowering of a man lift, etc.).

1. The Exclusion Zone must meet the following minimum requirements:
   - A minimum distance of 10 feet from all heavy equipment and loads being moved by the equipment;
   - Greater than the swing/reach radius of any moving part on the heavy equipment (i.e., for large equipment this may mean an exclusion zone distance larger than 20 feet);
   - Greater than the tip-over distance of the heavy equipment; and
   - Greater than the radius of blind spots.

   > The size of the Exclusion Zone will need to be determined on a task-specific basis considering the size of the heavy equipment in use and the task being performed. Prior to all heavy equipment operations, the Exclusion Zone(s) distance must be specifically identified in the Job Safety Analysis (JSA).

2. The spotter (or another individual) should be assigned responsibility for enforcing the Exclusion Zone. The spotter should be positioned immediately outside of the Exclusion Zone within a clear line of sight of the equipment operator. The spotter must signal the operator to stop work if anyone or anything has the potential to enter or compromise the Exclusion Zone. The operator should stop work if the spotter is not within his/her line of sight. If multiple pieces of equipment are being used, each piece of equipment must have its own Exclusion Zone and spotter. For large excavation and demolition projects the spotter should be in constant radio contact (not cell phone) with the machine driver.
3. If an individual must enter the Exclusion Zone, the designated Spotter must signal the Equipment Operator to stop the equipment. Once the equipment is no longer moving (ex. movement of an arm of an excavator is STOPPED, lifting of a load with a forklift STOPPED, raising/lowering of a man lift is

STOPPED, etc.), the operator must DISENGAGE THE CONTROLS and STOP and SIGNAL BY "SHOWING HIS HANDS". This signal will indicate that it is safe for the personnel to enter the limits of the Exclusion Zone to perform the required activity. The equipment must remain completely stopped/disengaged until all personnel have exited the limits of the Exclusion Zone and the designated Spotter has signaled by "SHOWING HIS HANDS" to the Equipment Operator that it is safe to resume operations.

4. When entering the limits of the Exclusion Zone, personnel must at a minimum:
    - Establish eye contact with the operator and approach the heavy equipment in a manner that is in direct line of sight to the Equipment Operator;
    - Never walk under any suspended loads or raised booms/arms of the heavy equipment; and
    - Identify a travel path that is free of Slip/Trip/Fall hazards.
5. The Exclusion Zone should be delineated using cones with orange snow fence or solid poles between the cones, barrels, tape or other measures. For work in rights-of-way rigid barriers, such as Jersey barriers or temporary chain link fence should be used. For certain types of wide-spread or moving/mobile equipment operations, such delineation may not be practicable around pieces of equipment or individual work areas. In such instances, it is expected that the entire operation will be within a larger secure work area or that additional means will be utilized to ensure security of the work zone.

All subcontractors who provide heavy equipment operations to field projects must implement a program that meets or exceeds the expectations described above as well as any additional requirements that may be required on a client or site-specific basis.

3.1 Exceptions

It is recognized that certain heavy equipment activities may require personnel to work within the limits of the Exclusion Zone as specified in this program. Such activities may include certain excavation clearance tasks, drill crew activities or construction tasks. However, any such activity must be pre-planned with emphasis on limiting the amount and potential exposure of any activity required within the zone. The critical safety steps to mitigate the hazards associated with working within the Exclusion Zone must be defined in the JSA and potentially other project-specific plans (i.e., critical lift plans, etc.), and approved by the Roux Project Principal and client representative, if required, prior to implementation.

4. TRAINING

Many Roux projects have different requirements that are client-specific or site-specific in nature. It is the responsibility of the Project Principal (or Project Manager if delegated this responsibility by the Project Principal) to ensure that the workers assigned to his/her projects are provided orientation and training with respect to these client and/or site-specific requirements.