REMEDIAL INVESTIGATION WORK PLAN

Rickett's Dry Cleaner - Site # 546058
2017-2019 Doubleday Avenue
Ballston Spa (Milton), New York

Prepared For:

Contract# D009808, Work Assignment No. 2
New York State Department of Environmental Conservation
Division of Environmental Remediation
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1.0 INTRODUCTION

On February 27, 2020, HRP Associates, Inc. (HRP) was authorized to complete this New York State Department of Environmental Conservation (NYSDEC) Work Assignment (WA) No. 2 (D009808-02) for Remedial Investigation/Feasibility Study (RI/FS) at the Rickett's Dry Cleaners Site, located at 2017-2019 Doubleday Ave, Ballston Spa (Milton), New York. The scope of work for the RI portion of the Work Assignment, discussed herein, was developed based on HRP's review of documents detailing previous subsurface investigations completed at the property between 2008 and 2018, as well as discussions and planning with NYSDEC staff.

1.1 Purpose and Objectives

This site-specific Remedial Investigation (RI) Work Plan describes the details of the scope of work, including all proposed field activities, laboratory analyses, and data QA/QC evaluation that will be associated with the RI at the Rickett's Dry Cleaner Site. This document is intended to supplement information provided in the NYSDEC-approved *Generic Field Activities Plan for Work Assignments*, completed by HRP on August 8, 2019 and provided in **Appendix A** of this Work Plan.

The purpose of the RI is to characterize on-site environmental media and work to define the nature and extent of the suspected on-site source of groundwater contamination associated with the Rickett's Dry Cleaner site. In accordance with DER-10 *Technical Guidance for Site Investigation and Remediation (May 2010),* the primary objectives of the RI scope of work are to:

- Delineate the areal and vertical extent of contaminants in all media at or emanating from the site;
- Determine the surface and subsurface characteristics of the site, including topography, geology, and hydrogeology, including depth to groundwater and groundwater flow gradients;
- Identify the sources of contamination, the migration pathways, and actual or potential receptors of contaminants on or through air, soil, bedrock, sediment, groundwater, surface water, utilities, and structures at the site, without regard to property boundaries;
- Use the Fish and Wildlife Resource Impact Analysis (FWRIA) Decision Key included in DER-10 Appendix 3c to determine if the FWRIA is needed for the site and complete FWRIA as applicable, based on the Decision Key;
- Collect and evaluate all data necessary to evaluate the actual and potential threats to public health and the environment; and
- Collect the data necessary to evaluate any release to an environmental medium and develop remedial alternative(s) to address the release.

Due to the dilapidated condition of the dry-cleaner building and presence of friable asbestos, the NYSDEC has determined that it is unsafe to enter the building to perform tasks related to the RI at this time. Due to the lack of access of the suspected source area, the RI will be completed in two phases. The initial focus of the RI will be to better define the degree and extent of the overall plume in the area of the Site rather than these source areas directly. Once the building access issues have been resolved, a second phase of the RI will be completed to characterize the suspected source area, and further delineate the offsite plume, if necessary.

1.2 Site Description and Background Information

The Rickett's Dry Cleaner Site (#546058), located at 2017-2019 Doubleday Avenue, Ballston Spa (Milton), New York, (**Figure 1**) is the focus of this investigation. This property is approximately 1.3 acres in size, according to the Saratoga County online GIS map viewer. Two buildings are currently present on the Site, (1) a former dry-cleaning/laundromat building originally constructed in 1930 totaling approximately 22,024 square feet and (2) a self-serve car wash building constructed in 1983 and totaling approximately 2,250 square feet. Site operations were reported to have ceased in 2013 and the property is currently inactive.

The Site is connected to the municipal water supply and serviced by the municipal sanitary sewer. No records of septic systems at the Site have been identified in available records. The Site is zoned for commercial use, and surrounding properties in the area are mostly residential.

Dry cleaning operations were performed on the Site by Rickett's Laundry/ Rickett's Fabric Care Services/Rickett's Inc. from at least 1950 until 2013. Environmental investigations performed at the Site between 2008 and 2018 identified chlorinated volatile organic compounds (VOCs) in groundwater samples and in soil gas samples that exceed their respective criteria (NYSDEC Groundwater Standards or 33x EPA RSL for Industrial Air). Tetrachloroethene (PCE) has been detected in Site groundwater at concentrations up to 3,700 µg/l and trichloroethene (TCE) up to 1,300 µg/l, both above their New York State Ambient Water Quality Standard (TOGS 1.1.1) criteria of 5 µg/l. Associated reductive de-chlorination by-products (daughter compounds), including trans-1,2-dichloroethene, cis-1,2-dichloroethene, and vinyl chloride have also been detected at concentrations above the relevant standards in samples collected from the Site.

Data from previous investigations indicate that the groundwater plume at the Site is migrating off-site to the southeast and could pose a risk to residential properties in the area. The data collected during previous investigations have been reviewed and are discussed in more detail in the summary letter report prepared by HRP, *Re: Review of Previous Reports and Other Available Information*, on May 6, 2020.

1.3 Site Geology and Hydrogeology

According to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey, 100% of the Site area is mapped as Windsor loamy sand, with 3 to 8 percent slopes. Soil boring logs from previous investigations were reviewed as part of the preparation of this Work Plan, which indicate that fill materials comprised of sand and gravel with varying amounts of ash, coal, glass, and brick to depths of 2 to 4 feet below ground surface (bgs) are present on the Site. Underlying this fill, varying amounts of sand, gravel, silt, and clay are present which are interpreted to have originated through glaciolacustrine and/or till deposition.

Previous investigations have explored the subsurface to depths of 16 feet bgs using a Geoprobe® direct-push rig. Refusal was encountered in three locations during the 2008 investigation, and in all six locations explored in the 2017 investigation, generally at depths of 12 to 14 feet bgs. Three of these refusal locations were noted to have clay with fine sand or gravel at the bottom of the boring log, which could indicate the presence of an impermeable unit above the bedrock surface at the Site. Bedrock was not encountered at the Site during previous investigations.

Shallow groundwater in the overburden aquifer was encountered at depths ranging from 3 to 10 feet bgs and mapped to flow to the southeast, based on information from previous subsurface investigations. Precision Environmental Services calculated a hydraulic gradient of 0.085 feet/foot for the localized on-Site groundwater flow as part of their investigation in November 2017.

1.4 Areas of Concern

According to previous environmental reports and limited available historic Site records, the following areas of concern (AOC) were identified that had the potential to impact environmental media at the Site and require further characterization. Additional AOCs warranting further characterization may be identified during the course of implementing the RI.

- Trench and floor drains
- Former dry-cleaning equipment/operations
- Loading/unloading areas
- Former 10,000-gallon above-ground storage tank (AST)
- Exterior dumpster and drum storage area
- Former fuel oil tank in original building (circa 1950)
- Former 275-gallon AST
- Former car wash operations
- Former railroad and nearby coal storage yards (circa 1910)

The contaminants that are commonly associated with onsite dry-cleaning operations, vehicle washing operations, and the former presence of fuel oil tanks at the Rickett's Dry Cleaner Site consist of VOCs, semi-volatile organic compounds (SVOCs), metals, cyanide, polychlorinated biphenyls (PCBs), per-polyfluoroalkyl substances (PFAS), chlorinated herbicides and pesticides, and 1,4-dioxane. Based on the results of previous investigations, known contaminants of concern onsite include VOCs, PFAS, and 1,4-dioxane. During previous investigations the highest concentrations of VOCs (predominately chlorinated VOCs) have been reported in soil vapor and groundwater samples collected below the central portion of the building, near the former dry-cleaning equipment area, and former 10,000-gallon AST (presumed to have held chlorinated solvents). This area below the central portion of the building is suspected to be a primary release area of these substances to the subsurface soils and groundwater. However, due to the dilapidated condition of the dry-cleaner building and presence of friable asbestos, the NYSDEC has determined that it is unsafe to enter the building to perform tasks related to the RI at this time. Therefore, the focus of the RI will be to better define the degree and extent of the overall plume in the area of the Site rather than these source areas directly.

Previous investigations performed sampling and laboratory analysis of VOCs, PFAS, and 1,4-dioxane; however, the presence of other potential onsite contaminants have not been evaluated in onsite soils or groundwater to date. Therefore, in order to define the nature and extent of the contamination at the Site, HRP will collect soil and groundwater samples for laboratory analysis of the known contaminant of concern parameters (VOCs, PFAS, and 1,4-dioxane), in addition to the following parameters: SVOCs, metals, cyanide, PCBs, chlorinated herbicides and pesticides.

2.0 REMEDIAL INVESTIGATION (RI) SCOPE OF WORK

This scope of work has been designed to gather data to evaluate each project objective listed in **Section 1.1**. The following sections provide specifics regarding the scope of work developed under this NYSDEC-approved Work Assignment (D009808-02) in support of a Remedial Investigation at the Rickett's Dry Cleaner Site (#546058).

2.1 Preliminary Activities

As part of the scope of work, the following documents have been prepared under this Work Assignment:

- Project-specific Work Plan (this document) to accompany the generic Field Activities Plan (FAP) (included as Appendix A of this Work Plan).
- Site-specific Health and Safety Plan (HASP) (included as **Appendix B** of this Work Plan).
- Generic Quality Assurance Project Plan (QAPP) (included as **Appendix C** of this Work Plan).

These NYSDEC-approved generic FAP, HASP, and QAPP are on file with the NYSDEC. The site-specific elements are provided below.

2.1.1 Work Plan

This RI Work Plan has been prepared for use in performing the Remedial Investigation, and will serve as the "site-specific FAP". This RI Work Plan identifies the components of the Remedial Investigation and a description of the tasks to be performed including the specific methods or procedures that will be used to conduct the field sampling. A proposed project schedule is included in **Section 4.1** of this RI Work Plan.

2.1.2 Health and Safety Plan

A site-specific Health and Safety Plan (HASP) (included as **Appendix B** of this Work Plan). The site-specific HASP provides guidance to maximize health and safety of on-site workers during RI - specific tasks including media sampling, installation of wells, surveying and other field related activities. Included in the site-specific HASP is a Community Air Monitoring Plan (CAMP) that details procedures for air monitoring during intrusive activities. The CAMP will be implemented during intrusive activities, described in **Section 2.2.2** of this Work Plan. The generic HASP has guidelines for health and safety supervision, air monitoring, medical monitoring, personal protective equipment, site controls, safe work practices and decontamination, etc.

2.1.3 Quality Assurance Project Plan

A site-specific Quality Assurance Project Plan (QAPP) has been prepared and is included in **Section 3** of this RI Work Plan. The site-specific QAPP was prepared as a supplement to the Generic QAPP with necessary site-specific information. Deviations from the protocols specified in the QAPP will be subject to the NYSDEC approval.

The Generic QAPP provides general information related to QA/QC procedures associated with the collection and analysis of samples of environmental media and includes specific representative standard operating procedures (SOPs) applicable to sample handling and field instrumentation use. Information provided in the Generic QAPP includes definitions and generic goals for data quality and required types and quantities of QA/QC samples. The procedures address field documentation; sample handling, custody, and shipping; instrument calibration and maintenance; auditing; data reduction, validation, and reporting; corrective action requirements; and QA/QC reporting specific to the analyses performed by the laboratories that are used for analysis of environmental media collected under Standby Contract No. D009808.

All laboratory analytical work will be performed by a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) approved laboratory certified in all categories of Contract Laboratory Protocol (CLP) and Solid and Hazardous Waste analytical testing. A Data Usability Summary Report (DUSR) will be included in the Remedial Investigation Report (RIR) for each round of analytical work. Category B deliverables will be retained in the project files and available for full data validation by a qualified, independent third party.

2.2 Investigation, Environmental Sampling, and Implementation

The RI will include the components described below and will consist of subsurface/intrusive characterization. The RI will consist of characterizing and sampling of the subsurface soil, soil gas, and groundwater to meet project objectives. The number and type of samples to be collected is discussed below and summarized on **Table 1**. The field investigation tasks for the Rickett's Dry Cleaner site are listed below in the order that they will be completed:

1. Underground Utility Identification, Clearance and, Location using Ground-Penetrating Radar (GPR)
2. Subsurface Soil Investigation (test pits and soil boring installation and sampling)
3. Groundwater Characterization (well installation and sampling)
4. Characterization and Disposal of Investigation Derived Waste
5. Off-site Soil Vapor Intrusion Investigation (air and soil vapor sampling)
6. Analytical Data Quality Evaluation
7. Base Map Development and Site Survey

2.2.1 Underground Utility Clearance and Ground Penetrating Radar (GPR)

Prior to implementing any intrusive activities, a utility clearance will be conducted. HRP will rely upon multiple lines of evidence to ensure to the maximum extent practicable that subsurface features are identified prior to commencement of intrusive work.

HRP will mark sampling locations prior to installation and contact public utility clearance services to mark out the utilities prior to the survey. The drilling contractor, or HRP, will request utility mark outs through NYS Code Rule 753/Dig Safe System. The dig safe system is limited to public right-of ways and will only identify utilities entering private property rather than utilities present on-site.

HRP will utilize a qualified subcontractor to conduct a survey to attempt to locate possible piping and utilities prior to drilling in any areas that are suspect. In order to identify the potential for buried piping, including the discharge piping form the floor drain and other dry cleaning equipment at the site, a GPR survey will be completed at the site. Areas included in the GPR survey are depicted on **Figure 2**.

GPR is a non-destructive and non-intrusive geophysical exploration technique that uses radar waves to detect subsurface objects, such as tanks, drums and piping. The GPR is also capable of detecting discontinuities in the subsurface materials indicative of excavated and backfilled areas, such as those associated with possible (underground storage tank) UST graves. The objective of performing this survey is not only make subsurface investigation as safe as possible for the field staff while protecting utilities, but also to identify possible sources and migration pathways (utility corridors, etc.). All anomalies identified during the GPR survey will be marked out in the field.

If necessary, the upper five feet at all boring locations will be cleared of any underground utilities by non-mechanical means, such as hand-digging methods.

2.2.2 Subsurface Characterization

In an effort to assess the nature of subsurface soil at the site, the unconsolidated soils at the Site will be evaluated at representative locations. It is anticipated that any soil cuttings will be containerized and labelled in 55-gallon drum(s) for proper disposal. Further discussion of investigation derived waste is discussed in **Section 2.2.5**. These proposed testing locations are provided on **Figure 2**; exact locations may vary based on the results from the GPR survey.

2.2.2.1. Advancement of Exploratory Test Pits and Soil Borings

Up to four (4) exploratory test pits will be installed using an excavator at exterior locations (**Figure 2**) to observe, collect and characterize soils in the vicinity of potential release areas. The test pits will target three areas on the eastern side of the building and one area on the western side of the building, near MW-11/PES-6. All soil samples will be screened for organic vapors using a photo-ionization detector (PID) and any evidence of contamination will be noted and/or used for selection of soil samples for laboratory analysis. Two (2) samples (one surficial/shallow sample and one subsurface sample) will be collected from each test pit for laboratory analysis of VOCs. One sample from each test pit will be submitted for laboratory analysis of the full list of parameters:

- Target Compound List VOCs +10 by EPA Method 8260
- Target Compound List SVOCs +20 by EPA Method 8270
- Target Analyte List metals by EPA Method 6010B
- Total cyanide by EPA Method 9012
- Total mercury by EPA Method 7471A
- Target Compound List PCBs by EPA Method 8082
- Target Compound List chlorinated herbicides, pesticides by EPA Method 8081B
- PFAS Analyte list compounds by modified EPA Method 537

- 1,4-dioxane by EPA Method 8270

Up to ten (10) soil borings will be advanced using a hollow stem auger (HSA) drilling rig or similar to collect continuous soil samples and characterize subsurface conditions from surface grade to approximately 20 feet bgs or refusal. Specifically, HRP will collect data to determine the characteristics of the till at the Site and the distribution of contamination in exterior soils. Soils will be collected with a split spoon sampler in 5-foot intervals or at each change of lithology, for descriptive characterization. All soil samples will be screened for volatile organic vapors using a PID, and any evidence of contamination will be noted and used for selection of soil samples. Up to three (3) soil samples will be collected from each soil boring and submitted for laboratory analysis of VOCs. Additionally, at select soil boring locations (**Table 1**) one sample boring will be submitted for laboratory analysis of the full list of characterization parameters:

- Target Compound List VOCs +10 by EPA Method 8260
- Target Compound List SVOCs +20 by EPA Method 8270
- Target Analyte List metals by EPA Method 6010B
- Total cyanide by EPA Method 9012
- Total mercury by EPA Method 7471A
- Target Compound List PCBs by EPA Method 8082
- Target Compound List chlorinated herbicides, pesticides by EPA Method 8081B
- PFAS Analyte list compounds by modified EPA Method 537
- 1,4-dioxane by EPA Method 8270

Duplicate and matrix/matrix spike duplicates will be collected at a frequency of 1 per 20 samples. Trip blanks will be submitted at a frequency of one per cooler per day if analysis for VOCs is included in the sampling set within the cooler.

As described in **Section 1.3** of this Work Plan, soils previously identified on the Site are generally varying amounts of sand, silt, gravel and clay to depths of 12 to 16 feet bgs, where Geoprobe® refusal was encountered. In order to evaluate the deeper subsurface lithology, a hollow stem auger will be advanced through the overburden as part of this RI, which will allow for exploration of the subsurface through more challenging geologic conditions. If a confining layer is determined to be present at the base of the till materials, care will be taken during drilling activities to prevent puncturing the layer while obtaining sufficient data to demonstrate that it is a true confining layer, which may include the installation of monitoring wells set in the confining layer.

Alternatively, if no evidence of an impermeable unit is identified above the bedrock surface, the augers will be advanced into the weathered bedrock surface sufficient to allow coring into the bedrock. Coring will be performed to produce a borehole of sufficient diameter to support a 2-inch diameter monitoring well approximately 10 feet into competent bedrock. A capped PVC casing will be grouted into the socket with a protective casing installed at the surface. The grout and the concrete will be allowed to set for 24 hours before proceeding with continuous coring runs of less than 5 feet through the PVC casing into the bedrock to a maximum depth of 15 feet beyond where competent rock was observed. Fractured rock samples collected near any water bearing fractures will be screened for VOCs using a PID, and potentially for laboratory analysis if field observations indicate the potential for bedrock matrix diffusion.

The soil boring investigation will begin with the proposed locations on Union Street and the car wash building to evaluate the subsurface geology below 16 feet bgs before installing any borings closer to the suspected source area below the building.

2.2.2.2. Soil Sample Collection and Handling Procedures

Soil samples will be collected at an interval that is impacted based on physical observation (above or below the water table), olfactory senses, or elevated PID reading, if there is no evidence of impacted material the sample will be collected from the interval directly above the water table. Soil samples collected using the drilling rig will be collected using split-spoons or disposable acetate liners with a 1.75-inch diameter macro-core sampler. Samples collected from test pits will be obtained directly using manual sampling methods, if the pits comply with OSHA trenching and excavation stability requirements for slope and dimension. If personnel entry is not possible, samples will be collected from the test pits using a hand auger or directly from the excavation equipment.

The sampling equipment to be used includes stainless steel trowels, bowls, spoons, or scoops, hand auger, sample containers, sampling zip lock bags, and coolers with regular ice (blue ice will not be permitted) due to the potential presence of PFAS under evaluation at the Site.

Nitrile gloves will be worn at all times by personnel collecting and handling the samples. All non-disposable equipment and tooling used for sampling will be properly decontaminated between sampling locations and intervals. Decontamination procedures are described in **Section 2.2.4**. Soil samples will be collected using clean laboratory-supplied, appropriate containers (as listed in **Table 1**) and will be preserved on ice in coolers during field sampling activities. Target samples will then be submitted for laboratory analysis, and contingency samples will be stored at proper temperatures, as listed in **Table 1**, pending follow-up analysis as necessary. Duplicate and matrix/matrix spike duplicates will be collected at a frequency of 1 per 20 samples.

Protocols for the collection and analysis of water samples for per- and polyfluoroalkyl substances (PFAS) will be in accordance with the most recent NYSDEC and NYSDOH guidance. Additional information related to methodology and materials used to sample for PFAS is provided in Section 14 of the Generic FAP (included as **Appendix A** of this Work Plan).

If a confining layer is encountered during the subsurface exploration activities associated with this RI, samples of the confining layer will be collected per the methodology described above; however these samples will only be submitted for laboratory analysis of TCL VOCs.

2.2.3 Groundwater Characterization

For the purpose of evaluating groundwater quality and to obtain groundwater flow information, a total of ten (10) groundwater monitoring wells (anticipated to be 3 shallow overburden and 7 deeper wells) are proposed for installation as part of the RI. The proposed locations were selected based on a previously-mapped southeasterly overburden groundwater flow direction. The proposed locations of each well are presented on **Figure 2**. Samples will be collected from the newly-installed wells in addition to all viable existing wells at the Site and across Doubleday Avenue.

2.2.3.1. Monitoring Well Installation

A hollow-stem auger drilling rig will be advanced through the overburden materials and used to set shallow overburden monitoring wells, which are anticipated to be completed at depths of 12 to 16 feet below grade. The wells will ultimately be designed and installed such that the well screen will intersect the observed water table elevation. The deeper wells are intended to be paired with existing or newly-installed shallow overburden monitoring wells, and are anticipated to be installed to depths greater than 20 feet below grade. As discussed in **Section 2.2.2.1**, the target depth and construction of these wells will be dependent on the subsurface conditions encountered in the field.

Unless significantly elevated VOC concentrations are observed indicating that alternative materials such as stainless steel be used, monitoring wells are to be constructed of PVC solid well pipe riser and a ten foot PVC 10-slot screen that will be positioned to intercept the water table. Depending on the location of the well, it will be finished with either a 4-foot stick-up protective casing, or a flush mounted protective cover. All equipment will be appropriately decontaminated between sampling locations, as described in **Section 2.2.4**. Based on well location, any soil cuttings will be spread either on-site or containerized as discussed in **Section 2.2.5**.

Should competent bedrock be encountered during the drilling activities, wells will be installed to a depth of approximately 10 feet beyond the observed bedrock interface. Drilling activities are more thoroughly described in **Section 2.2.2.1** of this Work Plan. The overburden material will be drilled to bedrock using 6-1/4 inch inside diameter (I.D.) hollow-stem augers. Once bedrock is encountered, the inner bit will be removed and a temporary PVC casing will be grouted into place at the bedrock interface. The grout and the concrete will be allowed to set for 24 hours before proceeding with two continuous coring runs of less than 5 feet through the PVC casing into the bedrock. Depending on the location of the well, it will be finished with either a 4 foot stick-up protective casing, or a flush mounted protective cover.

2.2.3.2. Well Development

Each newly-installed well will be developed a minimum of 24 hours after completion by pumping and surging for 2 hours or until the field parameters stabilize for a minimum of three consecutive readings of 10 percent variability of less. The field parameters include: temperature, pH and specific conductance. In addition, the turbidity of the groundwater must achieve a reading of 50 Nephelometric Turbidity Units (NTUs) or less during the field parameter readings.

All purge water obtained during well development and sampling will be containerized and disposed of in accordance to NYSDEC DER-10. If impacts are observed, the contaminated groundwater will be segregated and handled as described in **Section 2.2.5**. All sampling equipment will be appropriately decontaminated between sampling locations or disposed of after a one time use.

2.2.3.3. Sampling of Monitoring Wells

Depth to water measurements will be collected from all monitoring wells to the nearest 0.01 foot from the surveyed points prior to sampling activities and the data will be used to construct a groundwater contour map to determine the direction of groundwater flow and the hydraulic gradient on the site. Until deemed unnecessary, in addition to measuring the water level, the wells will be checked for both light and dense non-aqueous phase liquids (LNAPLs and DNAPLs) using an interface probe.

Groundwater samples will be collected from the newly installed wells a minimum of seven days after well development has been completed. Groundwater samples will also be collected from a minimum of nine (9) existing monitoring wells at the Site and downgradient of the Site, across Doubleday Avenue. One additional well (MW-14) will also be sampled if it is located in the field. All groundwater samples will be collected in accordance with low-flow groundwater sampling procedures and will be submitted to Test America, an NYSDOH ELAP-certified laboratory for analysis of VOCs. Duplicate and matrix/matrix spike duplicates will be collected at a frequency of 1 per 20 samples. Additionally, samples collected from monitoring wells PES-5 and MW-12 will be submitted for laboratory analysis of PFAS, and samples collected from several monitoring wells (PES-1, PES-3, PES-6, MW-10, MW-13 and proposed MWs adjacent to former carwash building, on Union Street, and on Park Street) will be submitted for laboratory analysis of the full list of characterization parameters:

- Target Compound List VOCs +10 by EPA Method 8260
- Target Compound List SVOCs +20 by EPA Method 8270
- Target Analyte List metals by EPA Method 6010B
- Total cyanide by EPA Method 9012
- Total mercury by EPA Method 7471A
- Target Compound List PCBs by EPA Method 8082
- Target Compound List chlorinated herbicides, pesticides by EPA Method 8081B
- PFAS Analyte list compounds by modified EPA Method 537
- 1,4-dioxane by EPA Method 8270

2.2.4 Decontamination Procedures

Non-dedicated sampling equipment (i.e., submersible pumps, water level indicators, etc.) will be subject to decontamination procedures prior to each sample collected to reduce the potential for cross-contamination, as described in the Generic Field Activities Plan (FAP) (included as **Appendix A** of this Work Plan). The decontamination procedures will include the use of a scrub wash with a solution consisting of Alconox® detergent and potable water followed by a rinse with DI water. Liquinox® will not be used if samples are to be collected for 1,4-dioxane analysis, since Liquinox® may contain a small amount of 1,4-dioxane. The decontaminated equipment will be stored in clean environments (i.e., the manufacturer's storage case). Decontamination fluids will be properly labeled and securely stored in the designated waste-container staging area.

2.2.5 Disposal of Investigation Derived Waste

Derived waste (DW) that is generated from the subsurface characterization, monitoring wells installation and the development of monitoring wells shall be handled in accordance with NYSDEC DER-10. HRP will be responsible for supplying the equipment and materials necessary for the proper handling and storage of the DW, such as DOT-approved 55-gallon drums, roll-off containers and/or holding tanks. All containers will be labeled and stored properly.

Soil shall be handled and disposed of in accordance with DER-10. If off-site disposal of the derived waste is required, it will be disposed of or treated according to applicable local, state and federal regulations. Soils from the RI/FS may be disposed within the direct push hole provided the hole will not be used for the installation of a monitoring well (cuttings may be used to backfill holes resulting from soil sampling), the direct push hole did not penetrate an aquitard nor an aquiclude, and backfilling the hole with cuttings will not create a significant path for vertical movement of contaminants. Soil additives (bentonite) may be added to the cuttings to reduce permeability. Six (6) inches of cohesive, compacted soil should be placed over the area of the hole.

The cuttings and spoil from several wells which are chemically compatible may be collected and disposed at one on-site location if they cannot be disposed in their respective boreholes. Material that is visually stained, creates high PID measurements, or exhibits strong odors shall be sampled and analyzed to ensure chemical compatibility with other cuttings before placing the materials in a common storage/disposal area if staining is present in the cuttings. Additionally, cuttings which are stored/disposed on-site in bulk (not in containers) shall be monitored for volatile emissions and for fugitive dust emissions. Monitoring instruments available at the Site as determined by the site-specific HASP may generally be sufficient. If any action level specified in the HASP is exceeded, corrective actions such as interim cover, placement in containers, etc., shall be implemented promptly.

It is anticipated that purge water generated during the development of the monitoring wells will require off-site disposal based on the previous Site data. Groundwater that is apparently contaminated based on field observations will be segregated from groundwater that does not exhibit evidence of apparent contamination.

Decontamination fluids will be containerized separately from other RI derived waste, and any decontamination fluids that do not exhibit evidence of contamination will be containerized separately from those exhibiting evidence of contamination.

2.2.6 Off-site Soil Vapor Intrusion Investigation

In an effort to assess the migration of gaseous vadose zone contamination and verify previous data, an off-site soil vapor intrusion investigation will be performed at a nearby residence (**Figure 2**), which adjoins the Site to the southeast, across Doubleday Ave. The vapor intrusion investigation will consist of one (1) sub-slab soil gas, one (1) indoor air sample, and one (1) ambient air sample collected during the heating season.

The soil gas sample will be completed and sampled in accordance with the New York State Department of Health's Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006. The general proposed locations of the sampling points are provided on **Figure 2**. Specific locations will be chosen with consultation with the NYSDEC and the NYSDOH and as field conditions allow. Weston Solutions reportedly installed a permanent sub-slab soil gas point (P001-18131-01) at the sample location in 2018. The sub-slab sample will be collected from this existing soil gas point if it is found to be usable upon inspection in the field. If it is determined to not be possible to use the existing point, HRP will install a new sub-slab access point in an adequate location beneath the concrete slab per the manufacturer's (Vapor Pin^{TM}) standard operating procedure (SOP), and using leak detection testing to confirm the competency of the vapor point.

Air samples will be collected simultaneous to sub-slab samples, and will be placed at a height corresponding to the average breathing level (i.e. approximately five feet above the ground surface). Collected at a flow rate of 0.2 liters/minute, the sampling duration will be at least 24-hours. Soil gas and air samples will be collected in Summa canisters, and analyzed using USEPA Method TO-15. Samples will be submitted to Test America LLC, an ELAP-approved laboratory. Prior to sampling, the integrity of the seal will be evaluated using a helium tracer gas. In the event that the probe fails the tightness test, the subsurface probe seal will be modified and the integrity testing repeated. In addition, a chemical inventory of the rooms where samples will be located will be completed prior to sampling.

2.2.7 Analytical Data Quality Evaluation

This Work Plan and the associated site-specific QAPP Section detail the data quality objectives and analytical requirements needed for this WA. All quality assurance protocols will be provided in the Generic QAPP.

During the final Work Plan review period, the site-specific QAPP Section and Work Plan will be reviewed and modified according to NYSDEC requirements and comments. Once the plans are finalized, deviations, if required, from protocols specified in the plans will be approved in advance by NYSDEC. As required, the selected analytical laboratory will maintain NYSDOH ELAP certification in all categories of CLP and Solid and Hazardous Waste analytical testing for the duration of the project.

The selected laboratory will supply all required data deliverables (USEPA CLP and NYSDEC ASP deliverable format) to enable the data to be validated. All environmental data will be submitted electronically in a specified format named 'NYSDEC' in accordance with the data submission procedures outlined on the NYSDEC's web site (http://www.dec.ny.gov/chemical/62440.html).

Upon receipt of the sample data, the validation contractor will quantitatively and qualitatively validate the laboratory data. The validation of the analytical data will be performed according to the protocols and QC requirements of the analytical methods, the USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic and Inorganic Data Review (February 1994), the USEPA Region II CLP Data Review SOP, and the reviewer's professional judgment.

2.2.8 Base Map Development and Site Survey

The subject property and surrounding areas will be surveyed by a New York State licensed land surveyor. The field survey will include establishing project horizontal control and the collection of planimetric features for the development of 2D mapping. As discussed in **Section 1.4** of this Work Plan, the building has been deemed unsafe for entrance due to the dilapidated condition of the structure and the suspected presence of friable asbestos; therefore, only the exterior Site features will be recorded on the survey. Subsequently, a base map of the Site will be developed using Computer Aided-Design (CAD) software that will be utilized to place all sampling locations from previous on-site and off-site investigations. The sample locations will be placed on the base map by geo-referencing previous figures into the local CAD coordinate system, and will include all monitoring wells, Geoprobe® locations, borings, bedrock profile data, and soil gas points.

Upon completion of the investigation fieldwork, a survey will be conducted in order to properly locate all sampling points such as monitoring wells, soil borings, soil vapor intrusion samples, and any other sample locations. The elevations of all monitoring well casings will be established to within an accuracy of plus or minus 0.01 feet based on an arbitrary local vertical benchmark. A notch will be etched in all interior casings, or a permanent black mark, to provide a reference point for all future groundwater elevation measurements.

2.3 Remedial Investigation Report

2.3.1 Electronic Data Delivery

In addition to appropriate data summary tables and boring logs included in the report, all environmental data will be submitted electronically in a specified Electronic Data Deliverable (EDD) format named in accordance with the data submission procedures outlined on the NYSDEC's web site (http://www.dec.ny.gov/chemical/62440.html).

2.3.2 Remedial Investigation Report

The Remedial Investigation Report (RIR) will be prepared as part of this work assignment following completion of the field activities. The RIR will provide a description of the field activities, present data collected during field characterization, present a physical description of the Site including geology and hydrogeology, and provide an analysis and interpretation of the available data in the context of existing Site conditions. The report will include tabulated laboratory analytical results, Site maps and a discussion of contaminant concentrations, including a comparison to NYSDEC Standards, Criteria and Guidelines as described in Section 3.14 of DER-10 and in accordance with New York State Department of Health guidelines for human health exposure assessment as described in Appendix 3B of DER-10 to support each conclusion of the RI.

The RIR prepared as part of this assignment will also provide a data validation/usability evaluation, identification and location of contaminants, assessment of potential contaminant migration pathways, impact on human and environmental receptors, and conclusions regarding the significance of the findings. The proposed work will provide delineation and extent of contamination, in the area of the Site. The results of the RI will used to evaluate and select a remedial plan of action for the site.

The submitted report will include the report text, appropriate tables, figures, photographs, data summary tables, and boring logs in a PDF format on a compact disc. The electronic file will contain 'bookmarks'. In addition, one hard copy of the report will be sent.

2.4 Feasibility Study and Alternatives Analysis

Subsequent to the field activities and RIR, a Feasibility Study (FS) and Alternatives Analysis (AA) will be prepared for the property as described in DER-10 Section 4.4(b) and 4.4(c). This will include various remedial options, framed by the known contamination, which will be introduced and discussed based on their efficacy, cost, and/or feasibility to provide a framework for selection of remedial strategies for Site cleanup and risk mitigation. The remedial alternatives will be evaluated with the understanding that additional characterization (geochemical data, evaluations of site-specific hydraulic parameters, and fracture analysis) and/or pilot testing at the Site may be valuable towards final remedial selection and design.

3.0 SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

This site-specific Quality Assurance Project Plan (QAPP) has been prepared as a companion Section to accompany the Generic QAPP for the standby subcontract prepared by HRP for the New York State Department of Conservation (NYSDEC) under Standby Contract No. D009808. The purpose of the QAPP is to specify QA/QC procedures for the collection, analysis, and evaluation of data that will be legally and scientifically defensible.

3.1 Site Specific Sampling

3.1.1 Sample Handling

Soil, groundwater, and air samples will be collected during this RI. Detailed sampling procedures are detailed in Section 4.0 of the Generic QAPP (included as **Appendix C** of this Work Plan). Matrix types, number of samples (including QA/QC) and analytical details are summarized in **Table 1** (follows text). Proposed sample locations are depicted on **Figure 2.**

3.1.1.1. PFAS Sampling

Sampling for PFAS will occur at the Site during the planned activities covered in this Work Plan. Specific requirements for field sampling procedures including precautions to be taken, pump and equipment types, decontamination procedures, and a list of approved materials to be used during sampling for PFAS compounds are included in Section 14.1 of HRP's Generic Field Activities Plan (FAP) (included as **Appendix A** of this Work Plan). Only regular ice will be used in the transport of samples being analyzed for PFAS.

The PFAS compounds will be analyzed by methods based on EPA Method 537.1. Specific PFAS compounds to be analyzed include:

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

Group	Chemical Name	Abbreviation	CAS Number
	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
Perfluorooctanesulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctanesulfonamidoacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

The minimum method achievable Reporting Limits for PFAS will be less than or equal to 2 ng/l (part per trillion [ppt]) for aqueous samples and 0.5 µg/kg (parts per billion [ppb]) for solids samples.

The laboratory Minimum Detection Limits as provided by Test-America for the PFAS compounds to be analyzed are as follows:

Analyte Description	MDL	Units	MDL	Units
	Aqueous		Solid	
M2-6:2 FTS		ng/l		µg/kg
M2-8:2 FTS		ng/l		µg/kg
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)	1.50	ng/l	0.0300	µg/kg
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)	1.70	ng/l	0.0340	µg/kg
Perfluorobutanesulfonic acid (PFBS)	0.490	ng/l	0.00880	µg/kg
Perfluorobutanoic acid (PFBA)	1.00	ng/l	0.190	µg/kg
Perfluorodecanesulfonic acid (PFDS)	0.900	ng/l	0.0190	µg/kg
Perfluorodecanoic acid (PFDA)	0.770	ng/l	0.0210	µg/kg
Perfluorododecanoic acid (PFDoA)	0.590	ng/l	0.0150	µg/kg
Perfluoroheptanesulfonic acid (PFHpS)	0.950	ng/l	0.0150	µg/kg
Perfluoroheptanoic acid (PFHpA)	0.910	ng/l	0.0230	µg/kg
Perfluorohexanesulfonic acid (PFHxS)	0.800	ng/l	0.0150	µg/kg
Perfluorohexanoic acid (PFHxA)	0.760	ng/l	0.0240	µg/kg
Perfluorononanoic acid (PFNA)	0.270	ng/l	0.0200	µg/kg
Perfluorooctanesulfonamide (PFOSA)	10.0	ng/l	0.00880	µg/kg
Perfluorooctanesulfonic acid (PFOS)	0.610	ng/l	0.0670	µg/kg
Perfluorooctanoic acid (PFOA)	0.810	ng/l	0.0140	µg/kg
Perfluoropentanoic acid (PFPeA)	0.630	ng/l	0.0180	µg/kg

Analyte Description	MDL	Units	MDL	Units
Perfluorotetradecanoic acid (PFTeA)	0.920	ng/l	0.0190	µg/kg
Perfluorotridecanoic acid (PFTriA)	0.600	ng/l	0.0130	µg/kg
Perfluoroundecanoic acid (PFUnA)	0.780	ng/l	0.0240	µg/kg

The laboratory SOP for PFAS analysis is attached (included as **Appendix D** of this Work Plan)**.**

3.1.1.2. 1,4-Dioxane Sampling

Sampling for 1,4-dioxane will occur at the Site during the planned activities covered in this Work Plan. Specific requirements for field sampling procedures include precautions to be taken, pump and equipment types, detailed decontamination procedures, a prohibition on using Liquinox, and approved materials only to be used for 1,4-dioxane are included in Section 14.2 of HRP's Generic Field Activities Plan.

The minimum method achievable Reporting Limits for 1,4-dioxane will be less than or equal to 0.35 µg/l (ppb) for aqueous samples and 0.1 mg/kg (parts per million [ppm]) in solids samples.

Laboratory provided specifics for 1,4-dioxane sampling MDLs and RLs is as follows:

Method	Analyte	Matrix	MDL	RL
8270D	1,4-Dioxane	Soil	0.055 mg/kg	0.1 mg/kg
8270D SIM	1,4-Dioxane	Water	0.1 µg/l	0.2 µg/l

3.2 Data Quality Assessment and Usability

Data quality objectives for the Rickett's Dry Cleaner site are focused towards 1) the characterization of releases of hazardous substances impacting environmental media at the Site and the downgradient study area and 2) the evaluation of the requirements and feasibilities of remediation in significantly impacted areas and/or a specific source area, if defined.

To achieve these objectives, QA/QC measures will be implemented throughout the RI investigation to provide input as to the validity and usability of data generated through soil, groundwater, soil gas and indoor air sampling. The procedures for data QA/QC management includes field documentation; sample handling, custody, and shipping; instrument calibration and maintenance; auditing; data reduction, validation, and reporting; corrective action requirements; and QA reporting specific to the analyses performed by the laboratory under subcontract to HRP. **Table 2** lists the sample containers, preservation, and holding time requirements for the parameters specific to this Site. These tables will be referenced by field personnel.

For all data generated during the RI, a Category B Data package and DUSR will be prepared to provide a thorough evaluation of analytical data utilizing third-party data validation. Don Anne of Alpha Geosciences will be the third-party data validator for this project. Mr. Anne's qualifications are attached (included as **Appendix E** of this Work Plan).

4.0 PROJECT MANAGEMENT

HRP has the responsibility of the overall management of this project and will respond to any NYSDEC requests. A proposed project schedule, key milestones, key project personnel, and project-specific subcontractors follow.

4.1 Project Schedule and Key Milestones

The proposed project schedule for this work assignment is outlined below. Key milestones are identified to monitor work progress. The following milestones will be applicable for this project:

		Est. Start Date
• Milestone 1:	RI WA Field Activity Plan development	Completed
• Milestone 2:	NYSDEC review of all site-specific plans	May - June 2020
• Milestone 3:	Subsurface soil sampling	June 2020
• Milestone 4:	Installation and sampling of monitoring wells	June/July 2020
• Milestone 5:	Removal of any investigation-derived waste	June/July 2020
• Milestone 6:	Off-site soil vapor intrusion investigation (heating season)	Fall 2020/Winter 2021
• Milestone 7:	Complete Data Validation	Winter 2021
• Milestone 8:	RIR	Winter 2021
• Milestone 9:	Feasibility Study and Alternatives Analysis	Spring 2021

The field work associated with soil and groundwater sampling (Milestones 3 and 4) will begin within 1-2 weeks of NYSDEC review and approval of all site-specific plans, contingent upon availability of subcontractors. Soil and groundwater samples will be submitted for laboratory analysis within 24 hours of field collection, and laboratory results can generally be expected within 10 days of submission. Any investigation-derived waste generated from the Site during the RI will be scheduled with the contractor to be removed within 1 week of the completion of Milestone 4, sampling of the monitoring wells. The timeframe of pickup and removal of this waste (Milestone 5) will be determined by the contractor upon scheduling. Soil vapor and air sampling will be performed at the down-gradient property (Milestone 6) during the heating season, which generally runs November 15 – March 31 of each year. Data validation (Milestone 7) will begin upon receipt of the first set of laboratory results, and will continue to be submitted for validation as the results are received from the laboratory. Data validation is expected within a four week timeframe. Milestone 7 will not be considered complete until data from the off-site soil vapor intrusion investigation has been validated. The RIR (Milestone 8) will be submitted as a draft report within 60 days after HRP receives the last round of analytical data from the laboratory. A second draft RIR will be submitted, if needed, within two weeks after the data validation company has reviewed the final analytical submitted for the investigation. A final version of the RIR will be submitted within two weeks after the DEC Project Manager's comments on both draft reports are received by HRP.

4.2 Key Project Personnel

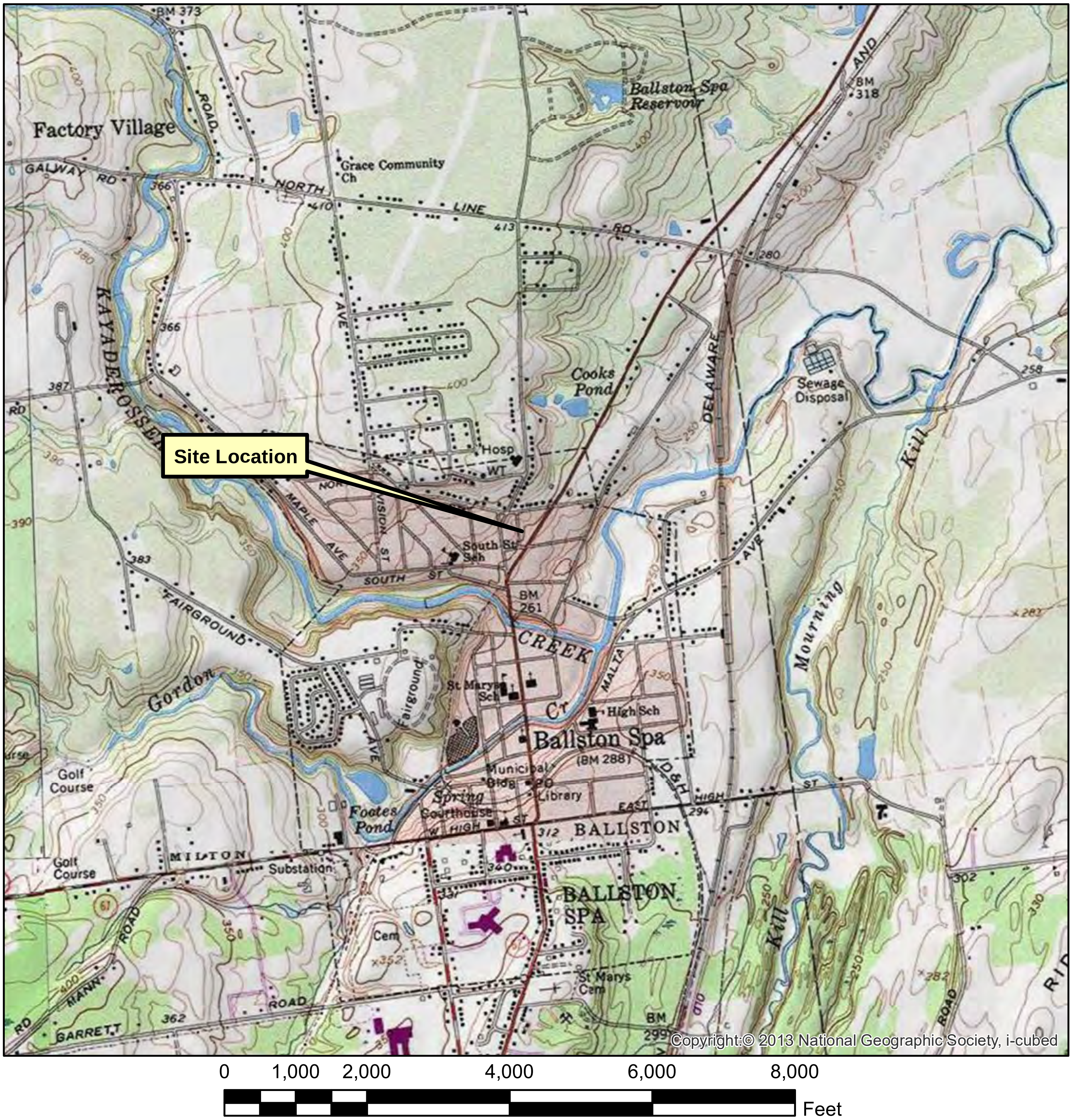
A list of the project personnel of the prime consultant and subcontractors responsible for performance of the investigation has been submitted to the NYSDEC for approval. Primary project staffs are listed below:

Personnel	**Company**	**Title for this Work Assignment**	**Responsibility**
Mark Wright PG, CSP (Project Manager)	HRP Associates, Inc. (Prime Consultant)	Project Manager	Overall management of the WA
Mark Wright PG, CSP (Project Manager)	HRP Associates, Inc.	Office Health & Safety Manager	Approval of HASP and responsible for overall health and safety issues with the WA
Michael Varni (Senior Project Geologist)	HRP Associates, Inc.	Corporate QA/QC Officer	Responsible for QA/QC on the WA
Stefan Truex, PG (Senior Project Geologist)	HRP Associates, Inc.	Field Manager and Site Health & Safety Officer	Responsible for the on-site sampling and investigative tasks

Subcontractors for this project will include:

- Survey – Susan M. Anacker Professional Land Surveyor, PLLC
- GPR – Greenstar Environmental Solutions, LLC
- Drilling – North Star Drilling
- Test Pits – MC Environmental Services, Inc.
- Laboratory – Test America to provide all media sample analyses
- Data Validation - Don Anne of Alpha Geoscienes
- Company to dispose of any investigation-derived waste (contingent upon analytical results)

FIGURES



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1 inch = 2,000 feet

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FIGURE 1
Site Location
Rickets Dry Cleaners - Site # 546058
2017-2019 Doubleday Avenue,
Ballston Spa, NY
HRP # DEC1002.P3
Scale 1" = 2,000'

USGS Quadrangle Information
Quad ID: 43073-A7
Name: Saratoga Springs, New York
Date Pub: 1970

MOVE YOUR ENVIRONMENT FORWARD

ONE FAIRCHILD SQUARE
SUITE 110
CLIFTON PARK, NY 12065
(518) 877-7101
HRPASSOCIATES.COM

Path: S:\Data\NYDEC - NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION\MILTON\2017 DOUBLEDAY AVENUE, BALLSTON SPA (MILTON), NY\DEC1002P3\GIS\Figure 1 - Site Location.mxd

LEGEND

- ● EXISTING MONITORING WELL
- ⊗ PROPOSED DEEP MONITORING WELL
- ⊗ PROPOSED OVERBURDEN MONITORING WELL
- △ PROPOSED AIR SAMPLE LOCATION
- ⬚ PROPOSED TEST PIT
- 🟧 AREA OF CONCERN

HRP
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NORTH

0 30' 60'

REVISIONS		
NO.	DATE	

DESIGNED BY: SRT
DRAWN BY: SRT
REVIEWED BY: MEW
ISSUE DATE: 06/22/2020
PROJECT NUMBER: DEC1001.P3
SHEET SIZE: 11"x17"

FIGURE 2
PROPOSED INVESTIGATION LOCATIONS
RICKETT'S DRY CLEANERS (SITE#546058)
2017-2019 DOUBLEDAY AVENUE
BALLSTON SPA (MILTON), NEW YORK

FIGURE
2

DRAWING NAME: S:\Data\N\NYDEC - NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION\MILTON\2017 DOUBLEDAY AVENUE, BALLSTON SPA (MILTON), NY\DEC1002P3\CAD\05-21-2020_ProposedSubsurfaceInvestigationLocations.dwg LAYOUT: RICKETTS Figure 2 PLOT DATE: Jun 22, 2020 - 11:29am OPERATOR: $(GETVAR,?)

TABLES

Table 1
Sample Summary
Rickett's Dry Cleaner- Site # 546058
2017-2019 Doubleday Ave, Ballston Spa (Milton), NY

Activity/ Matrix	Number of Sample Locations	Location	Samples to be Collected	Analyses
Test Pits/ Soil	4	Proposed Test Pits (Surface/ shallow Samples)	4	VOCs +10 by EPA Method 8260 SVOCs +20 by EPA Method 8270 TAL metals by EPA Method 6010B Total cyanide by EPA Method 9012 Total mercury by EPA Method 7471A PCBs by EPA Method 8082 chlorinated pesticides by EPA Method 8081A PFAS by modified EPA Method 537.1 1,4-dioxane by EPA Method 8270-SIM
		Proposed Test Pits (subsurface)	4	VOCs +10 by EPA Method 8260
Soil Borings/ Soil	10	Proposed Locations adjacent to: PES-2, PES-3, PSE-6, MW-13, Carwash Building, Park Street	6	VOCs +10 by EPA Method 8260 SVOCs +20 by EPA Method 8270 TAL metals by EPA Method 6010B Total cyanide by EPA Method 9012 Total mercury by EPA Method 7471A PCBs by EPA Method 8082 chlorinated pesticides by EPA Method 8081A PFAS by modified EPA Method 537.1 1,4-dioxane by EPA Method 8270-SIM
		Remaining Samples	Up to 20	VOC+10 by EPA Method 8260
Monitoring Wells/ Groundwater	18	PES-2, PES-3, PES-6, MW-10, MW-13, Proposed overburden wells near Carwash Building, Park Street, Union Street	7	VOCs +10 by EPA Method 8260 SVOCs +20 by EPA Method 8270 TAL metals by EPA Method 6010B Total cyanide by EPA Method 9012 Total mercury by EPA Method 7471A PCBs by EPA Method 8082 chlorinated pesticides by EPA Method 8081A PFAS by modified EPA Method 537.1 1,4-dioxane by EPA Method 8270-SIM
		PES-5, MW-12	2	VOCs +10 by EPA Method 8260 PFAS by modified EPA Method 537.1
		All proposed deep monitoring wells; PES-1, PES-4, MW-14, Proposed overburden well on Doubleday Ave	9	VOCs +10 by EPA Method 8260
Vapor Intrusion Study	1	Soil Vapor	1	VOCs by EPA TO-15
		Indoor Air	1	VOCs by EPA TO-15
		Outdoor Air	1	VOCs by EPA TO-15

Acronym List:
VOCs: Volatile Organic Compounds
SVOCs: Semi-Volatile Organic Compounds
TAL: Target Analyte List
PCBs: Polychlorinated Biphenyls
PFAS: Per- and polyfluoroalkyl substances

Table 2
Analytical Methods/Quality Assurance Summary
Rickett's Dry Cleaner- Site # 546058
2017-2019 Doubleday Ave, Ballston Spa (Milton), NY

					Containers per Sample			Preservation Requirements			
Parameter	**Matrix**	**Number of Samples (including Field QC)**	**Preparation Method**	**Analytical Method***	**No.**	**Size**	**Type**	**Temp.**	**Light Sensitive**	**Chemical**	**Maximum Holding Time**
SOIL											
VOCs by GC/MS	Soil/Sediment	50	5035A	SW-846 Method 8260B	3 vials 1 jar	40 ml vials, any size jar	glass vials clear glass jar	2-6º C	No	MeOH/ Sodium bisulfate/ freezing	14 days
SVOCs by GC/MS	Soil/Sediment	17	3546	SW-846 Method 8270C	1	8 oz	amber glass jar	2-6º C	Yes	NA	14 days
TAL Metals (except Hg) by ICP	Soil/Sediment	17	3050B	SW-846 Method 6010B	1	8 oz	clear glass jar	NA	No	NA	6 months
Mercury (Hg) by CV	Soil/Sediment	17	7471A	SW-846 Method 7471A	1	8 oz	clear glass jar	NA	No	NA	28 days
Total Cyanide	Soil/Sediment	17	9012	SW-846 Method 9012	1	8 oz	plastic bottle	2-6º C	No	NA	14 days
PCBs by GC	Soil/Sediment	17	3546	SW-846 Method 8082	1	8 oz	clear glass jar	2-6º C	No	NA	14 days
Chlorinated Pesticides by GC	Soil/Sediment	17	3546	SW-846 Method 8081A	1	8 oz	clear glass jar	2-6º C	No	NA	14 days
1,4-Dioxane	Soil/Sediment	17	3546	SW-846 Method 8270	1	8 oz	amber glass jar	2-6º C	Yes	NA	14 days
GROUNDWATER											
VOCs by GC/MS	Aqueous	23	5035	SW-846 Method 8260B	2	40 ml	glass vial	2-6º C	No	HCL	14 days
SVOCs by GC/MS	Aqueous	23	3510C	SW-846 Method 8270C	2	1 liter	amber bottle	2-6º C	Yes	NA	7 days
TAL Metals (except Hg)by ICP-	Aqueous	23	3005A	SW-846 Method 6010B	1	500 ml	plastic bottle	NA	No	Nitric Acid	6 months
Mercury (Hg) by CV	Aqueous	23	7470	SW-846 Method 7470A	1	250 ml	plastic bottle	NA	No	Nitric Acid	28 days
Total Cyanide	Aqueous	23	9010	SW-846 Method 9012A	1	250 ml	plastic bottle	2-6º C	No	NaOH	14 days
PCBs by GC	Aqueous	23	3510C	SW-846 Method 8082	2	liter	clear glass bottle	2-6º C	No	NA	7 days
Chlorinated Pesticides by GC	Aqueous	23	3510C	SW-846 Method 8081	2	liters	clear glass bottle	2-6º C	No	NA	7 days
PFAS	Aqueous	23	NA	Modified Method 537.1	3	250 ml	polypropylene	2-6º C	No	Trizma	14/28 days
1,4-Dioxane	Aqueous	23	3510C	SW-846 Method 8270 SIM	2	500 ml	Amber glass	2-6º C	Yes	NA	7 days
SOIL GAS, AIR											
VOCs	Soil gas, Air	6	NA	EPA TO-15	1	3-Liter, 6-Liter	Summa Canister, Tedlar Bag	NA	No	NA	30 Days (Summa Canister), 48 hours (Tedlar Bag)

Acronym List:

GC: Gas Chromatography
ICP: Inductively Coupled Plasma
HCL: Hydrochloric Acid
MeOH: Methanol

CV: Cold Vapor
VOCs: Volatile Organic Compounds
SVOCs: Semi-Volatile Organic Compounds
TAL: Target Analyte List

PCBs: Polychlorinated Biphenyls

APPENDIX A

NYSDEC-Approved Generic Field Activities Plan

MOVE YOUR ENVIRONMENT FORWARD

GENERIC FIELD ACTIVITIES PLAN FOR WORK ASSIGNMENTS

Prepared For:

New York State Department of Environmental Conservation
625 Broadway
Albany, NY 12233
Contract No. D009808

Prepared By:

HRP Associates, Inc.
1 Fairchild Square, Suite 110
Clifton Park, NY 12065

Issued On: August 9, 2019

LIST OF REVISIONS

Date	Summary of Changes	Approval
1/5/2009	Original document preparation	Jeffrey R. Sotek
8/1/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

TABLE OF CONTENTS

Appendices

1.0 PURPOSE AND OBJECTIVES

1.1 Purpose

This Generic Field Activities Plan has been prepared as a generic document to describe potential field activities that HRP Associates, Inc. (HRP) will perform or oversee for standby subcontract work assignments issued by the New York State Department of Environmental Conservation (NYSDEC) under Superfund Standby Contracts No. D009808. The principal purpose of this document is to describe and provide rationale for potential field activities that will be performed in association with projects Work Assignments under the contract. Specific details related to field activities for any given Work Assignment will be provided in the site-specific Work Plans developed for each project (hereinafter referred to as "Project-specific Work Plans").

1.2 Objectives of a Field Activity Plan

An initial step in every work assignment is the development of a project-specific Work Plan, which includes the preparation of a Field Activities Plan (FAP). The project-specific FAP is prepared to identify and describe anticipated field activities on a project-specific basis. This generic FAP provides detailed information about field activities that HRP, NYSDEC, and/or subcontractor personnel could potentially perform on or adjacent to a site associated with a Work Assignment. Such information includes the definition, rationale, protocol, and any construction details or operation and maintenance of field activities on a general basis. Specific activities and details associated with a specific Work Assignment that may not have been included in this generic FAP will be provided in the project-specific FAP that is included as an appendix to the project-specific Work Plan.

The elements of this Generic FAP have been prepared in accordance with the most recent and applicable guidelines and requirements of the NYSDEC Division of Environmental Remediation (DER) and the New York State Department of Health (NYSDOH), as well as other applicable guidance, as appropriate. Site-specific work plans, which include the field activities plan, will be developed separately under each individual work assignment or as requested by the NYSDEC or NYSDOH.

1.3 Responsibilities of the Consultant

HRP will be responsible for performing each Work Assignment in accordance with generally accepted processional practices and regulatory guidance to achieve the project goals as established by the NYSDEC. Examples of regulatory guidance documents that are likely to be applicable to projects performed under the contract include DER-10 *Technical Guidance for Site Investigation and Remediation* and the *Spill Guidance Manual*, published by NYSDEC, as well as *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, published by the NYS Department of Health (DOH).

HRP will prepare project-specific Work Plans for each Work Assignment that describe the approach to achieving the project goals, the methodologies and techniques that will be used during the performance of project activities, and responsibilities for each task under the individual projects. Each project-specific Work Plan will include a project-specific FAP and Quality Assurance Project

Plan (QAPP). HRP will be responsible for ensuring that the activities performed during the course of the Work Assignment adhere to the procedures described in those documents, as well as applicable federal, state, and local statutes, regulations, policies, and protocols.

2.0 BRIEF DESCRIPTION AND RATIONALE FOR FIELD ACTIVITIES

The primary focus of a Work Assignment is to evaluate existing conditions on the site, groundwater flow direction, the nature and extent of the contamination, and possible human exposure to the contaminants through a systematic site characterization or remedial investigation.

The following tasks are among those that are anticipated as potential activities that may be completed by HRP as part of a site investigation/characterization and/or a remedial investigation. Details of each of these field activities, which have been developed in accordance with applicable NYSDEC guidance (e.g. *DER-10*, *Spill Guidance Manual*, etc.), as well as other applicable and relevant guidance, as appropriate, are provided in indicated sections of this generic FAP. Additional information on procedures used during site characterization and/or remedial investigations is provided in HRP's Standard Operating Procedures (SOPs), which are provided in **Appendix A** of this generic FAP.

Section	**Field Activity and Objective**
3	***Direct-Push Drilling and Sampling*** – The objective for this activity is to advance soil borings and collect soil samples during the course of a subsurface investigation. During direct-push/Macro-Core® drilling, the subsurface soils are extracted, screened, and classified to identify soil types, and collect representative soil samples from selected depth intervals. Soil borings advanced using direct-push drilling techniques may also be used for subsequent installation of monitoring wells, and direct-push methods may also be used to collect "grab" groundwater samples using specific equipment designed for that purpose. Results of soil and "grab" groundwater samples will be used to identify possible source areas, characterize the overall concentration and distribution of contaminants in the subsurface, delineate the three-dimensional extent of contaminants of concern, whether remedial action will be necessary, and determine whether the site should or should not remain part of Inactive Hazardous Waste Site listing.
4	***Monitoring Well Installation*** – Monitoring wells will be installed to measure water levels in the wells, collect samples of groundwater from specific depths and locations in relevant zones of the aquifer(s), and evaluate hydraulic characteristics of the aquifer(s) using slug tests, and/or pumping tests at a site. Such information will be used to identify hydrogeologic considerations that could affect contaminant fate and transport and distribution of contamination in groundwater, which will, in turn, be used to evaluate plume migration potential and whether remedial action is necessary.
5	***Monitoring Well Development*** – Well development is important component of the monitoring well installation process because it helps ensure that water withdrawn from the well has been in good communication with the surrounding aquifer and that groundwater chemistry is representative of chemistry in the aquifer in the vicinity of screened interval of the well. All monitoring wells will

be developed at an appropriate time interval following installation using surging and pumping techniques. During well development, temperature, conductivity, pH, and turbidity will be monitored to demonstrate that values have stabilized and that values are within acceptable limits.

6 ***Groundwater Monitoring and Sampling –*** Monitoring water levels in monitoring wells is conducted to obtain water-level information that will be used to calculate water-level elevations, which are subsequently used to evaluate groundwater flow directions, as well as horizontal and vertical gradients across a site. Groundwater samples are collected to evaluate water quality at various locations and depths within an aquifer. Water-level monitoring and groundwater sampling will be conducted at periodic intervals identified in project-specific Work Plans to delineate the extent of contaminants of concern within a groundwater monitoring well network, temporary well installation, or direct-push sampling point.

7 ***Exploratory Test Pit Excavation and Sampling/Trenching –*** Excavation of exploratory test pits or trenches may performed as an appropriate subsurface exploration activity to observe in-situ conditions over a broader area than can be achieved from soil samples collected from one or more boreholes. Data collected from test pits and trenches can include both geologic and hydrogeologic information as well as chemical data from soil samples collected during, or following, excavation activities. Test pits and trenching may also be appropriate to better identify areas of fill or subsurface disposal.

8 ***Surface Water Sampling –*** Depending on site-specific conditions with respect to physical characteristics and contaminant distribution and transport at a site, collection of surface water samples from surface water bodies on or adjacent to the site might be necessary to evaluate whether impacts to surface water are present as a results of contamination present on a site and whether human or ecological receptors could be at risk. In some cases, surface water may act to convey contaminants of concern from the site, and in other cases, surface water bodies may represent potential receptors to contamination originating on a site. Surface water bodies may include streams, ponds, storm sewers, ditches, etc.

9 ***Sediment Sampling –*** Similar to the objectives for surface water sampling, collection of sediment samples from surface water bodies on or adjacent to a site is necessary to evaluate potential risk to ecological receptors or to evaluate the extent and distribution of contamination on or emanating from a site. Often, sediment sampling is conducted in conjunction with surface water sampling, but depending on the conceptual model for contaminant distribution at a site, sediment sampling alone may be deemed appropriate.

10 ***Soil Vapor Point Installation and Sampling –*** Soil vapor sampling may be conducted for two primary purposes – 1) identification of potential source areas for VOC contamination in the subsurface or evaluation of plume extent in the shallow zone of an aquifer and 2) evaluation of the potential for vapor intrusion into building. Although both applications involve the installation of soil vapor points into the subsurface for the purpose of collecting representative soil vapor samples for laboratory analysis, the techniques used and specifics of soil vapor point construction and sampling will be different depending on the purpose for the sampling. Specifics related to soil vapor point installation and sampling will be conducted in accordance with DOH soil vapor intrusion guidance (2006 *Guidance for Evaluating Soil Vapor Intrusion in New York State* and subsequent updates) and as determined by NYSDEC and in consultation with the NYSDOH.

11 ***Indoor Air Monitoring*** **–** Evaluating the quality of indoor air can be an important component of a vapor intrusion evaluation, depending on the results of sub-slab vapor sampling or if indicated as appropriate based on the 2006 DOH *Guidance for Evaluating Soil Vapor Intrusion in New York State* and subsequent updates. Sampling and analysis of indoor air will be conducted in accordance that guidance.

12 ***Community Air Monitoring*** **–** Monitoring concentrations of volatile organic compounds (VOCs) and particulate levels at the perimeter of the work area in real-time is an important component of any project for which the public could be at risk due to the release of VOCs or particulates into ambient air during the performance of investigation and/or remedial activities. Such monitoring may include a combination of continuous and periodic monitoring and design of such a monitoring program will be contingent upon site-specific field and construction activities.

13 ***Private Well/Tap Water Sampling*** **–** Sampling private water supplies may be an important task in certain contaminant characterization and remedial investigations. Objectives for such sampling can include the need to evaluate the extent of contamination in groundwater, as well as the need to evaluate potential risk to receptors of water from private water supply wells. Specific considerations related to sampling design and sample collection protocols will be dependent on project-specific objectives and the nature of contaminants and potential migration pathways.

14 ***PFAS Sampling and Analysis and 1.4-Dioxane Analysis*** **–** Since per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane and have become recognized as emerging contaminants, NYSDEC is requiring that all environmental media be sampled and analyzed for these contaminants in accordance with the most recent guidance. Sampling for PFAS requires specific sampling protocols due to the ubiquitous nature of PFAS compounds in many types of consumer products and generally acceptable materials used for collection of soil and groundwater samples. Laboratory analysis for PFAS and 1,4-dioxane also requires use of specific analytical methods due to the low detection limits necessary to evaluate potential risk.

15 ***Storage and Disposal of Waste*** **–** Management of investigation-derived waste is an important consideration in any subsurface investigation program. HRP will provide storage, handling, management, and disposal of investigative-derived waste in a manner consistent with applicable statutes, regulations, guidance and policies.

16 ***Site Survey and Base Map Preparation –*** Accurate plotting of all investigation/characterization locations on site plans is a critical component of a site investigation/remedial action program. HRP will locate all field sampling locations using a high-precision GPS unit, survey equipment, and/or licensed surveyor, as directed by the NYSDEC project manager or as indicated in DER-10. Monitoring wells will be surveyed with respect to elevation to an accuracy of 0.01 feet relative to a known site datum. A topographic survey and preparation of a site base map will be performed by a licensed professional land surveyor, if required by the NYSDEC project manager.

3.0 DIRECT-PUSH/GEOPROBE® DRILLING AND SAMPLING

The primary purpose of direct-push/Geoprobe® drilling and sampling is to evaluate the nature and quality of soil at depths less than approximately 100 feet from the ground surface and the quality of groundwater from the shallow overburden aquifer at a site to assess the nature and extent of contamination during site characterization and remedial investigations. Direct-push drilling techniques can also be used, often in conjunction with special tooling, for other applications during the site characterization process. Site-specific applications for direct-push drilling and sampling techniques will be provided in project-specific Work Plans. A description of the techniques used for the most common application, borehole advancement and soil sample collection, is provided below.

Direct-Push Borehole Advancement using Macro-Core® Sampling Techniques

Direct-push drilling techniques will be used to advance boreholes in unconsolidated materials whenever possible, primarily due to the limited amount soil removed from the subsurface per borehole and the speed with which boreholes can be advanced. During a direct-push drilling program, a Macro-Core® or similar sampling device will be used to collect soil samples from the subsurface during borehole advancement. Soil samples are collected continuously from each soil boring until a unit of low permeability (e.g., clay, bedrock) is encountered. Soil borings are commonly used to classify shallow overburden soils, collect soil samples, delineate the limits and extent of constituents of concern, install temporary monitoring wells/piezometers, install soil vapor points, and to allow the use of such direct-push equipment as temporary groundwater sampling devices and membrane interface probes.

During direct-push drilling using a Macro-Core® sampling device, the subsurface soils are extracted, screened, and classified to identify soil types, visualize potential contaminants, assess volatile organic carbon vapors within the soil, and collect representative soil samples from selected depth intervals. Photoionization detector (PID) measurements, as well as visual and olfactory observations and other field screening techniques will be used when selecting soil samples for potential laboratory analysis. Procedures for field screening are described in HRP SOP #108 *Field Screening*. More detailed procedures for soil boring advancement are provided in HRP SOP #101 *Soil Boring Advancement*.

The selection of subsurface soils for laboratory analysis is made in consultation with a NYSDEC field representative, when present onsite, and are based the following parameters:

1. Subsurface soil materials that exhibit visual signs of contamination.
2. Subsurface soil materials that cause a sustained response above the measured background response on a calibrated flame or photo ionization screening instrument.
3. A combination of Items 1 and 2.
4. Knowing the history of the site, if possible.

Soil samples selected for analysis will be submitted to an approved NYSDOH Laboratories Approval Program (ELAP)-certified laboratory for analysis in accordance with NYSDEC Analytical Service Protocol (ASP) and U.S. Environmental Protection Agency (USEPA) methods. Specific analyses to be performed and the methodologies that will be used will be identified in the project-specific Work Plan and QAPP.

At a minimum, soil samples collected from the most contaminated interval at each soil boring location, based on instrumental, visual, and/or olfactory evidence (i.e. high PID reading, visually stained, or strong odor), will be sent to a certified laboratory for analysis. If no contamination is detected or observed, a subsurface soil sample collected at the water table interface or directly above the low permeability unit, whichever occurs first will be submitted for analysis. Soil samples may also be selected for laboratory analysis based on the conceptual site model for the site or area concern based on the suspected release mechanism and the depth at which contamination is most likely to be encountered. Soil sampling will be conducted in accordance HRP SOP #104 *Soil Sampling*. Soil samples to be submitted for laboratory analysis for VOCs will be collected in accordance with HRP SOP #105 *Soil Sample Collection for VOC Analysis*, which describes the methods used to collect and preserve soil samples in accordance with USEPA Method 5035.

All soil borings will be classified and logged, at a minimum, according to the Unified Soil Classification System (ASTM Standard D2487-17, *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System*), as indicated in DER-10. Soils may also be classified according to ASTM Standard D2488-17, *Practice for Description and Identification of Soils (Visual-Manual Procedure)* and/or HRP SOP# 103 *Soil Logging Using a Modified Burmister Classification System*, as requested for each Work Assignment and as appropriate based on project-specific data quality objectives (DQOs). A field record of the soil classifications for each soil boring, sampling interval, PID readings, and other field observations/field-screening results will be recorded on a soil boring log form provided in **Appendix B**.

Any soil brought to the surface during borehole advancement will be managed in accordance with procedures described in DER-10 Section 3.3 (e), as described in Section 15.

4.0 MONITORING WELL INSTALLATION AND CONSTRUCTION

Monitoring wells are installed and constructed to identify hydrogeologic characteristics, groundwater constituents, contaminant transport, extent of groundwater contamination in the horizontal and vertical dimensions, and the hydraulic relationship between the site and localized groundwater flow direction. The exact location of monitoring wells are based upon the information collected during the field investigation activities, knowledge of the existing distribution of contaminants, historical data and preliminary site assessment results. If there are existing monitoring wells at a site, all new monitoring wells will be constructed similar to the construction of the existing monitoring well network, if feasible and appropriate. Specific information related to monitoring well location and construction will be provided in the project-specific Work Plan.

4.1 Types of Monitoring Wells

Permanent (shallow, intermediate, deep) or temporary monitoring wells will be installed depending on project-specific DQOs. The actual depth to which permanent wells will be installed will vary depending on groundwater monitoring objectives and site geology/hydrogeology. Temporary monitoring wells or sampling points will be used for short-term monitoring events when consistent with project=specific objectives.

Monitoring well identification will start with “MW-#” notation. Shallow, intermediate, or deep depth wells will be identified with an “S”, “I”, or “D” that is immediately preceded by the well number (e.g., “MW-#I”).

Shallow depth monitoring wells will be used for monitoring water-table elevations or collecting analytical data that is not sensitive to significant fluctuations in the water table. Monitoring wells screened below the water table at intermediate to deeper depths within an aquifer are use used to evaluate the vertical extent of contamination in an aquifer or in a particular hydrogeologic zone and to evaluate vertical hydraulic gradients in an aquifer. The drilling and installation of monitoring wells will be supervised and documented by a field geologist according to the procedures described in Sections 4.2 and 4.3.

4.2 Temporary Monitoring Well/Sampling Point Construction

All wells will be installed in accordance with the approved project-specific Work Plan. Temporary groundwater monitoring wells or sampling points will be installed using direct-push techniques to the appropriate depth. A temporary 1- to 2-inch diameter well will be installed into an open borehole. The temporary monitoring wells will be constructed with an appropriate length of 0.010-slot screen and an appropriate length of Schedule 40 PVC riser to the ground surface. The annulus space will be backfilled with sand to approximately 2 feet above the screened interval. A bentonite seal will be placed from the top of the sand to the ground surface to and a well cap will be installed at the top of the riser to eliminate potential run-off from rain events or spills into the temporary monitoring well.

In some cases screen-point groundwater samples will be collected using direct-push drilling techniques and a screen-point sampling device designed to be used in conjunction with direct-push drilling rigs. Sample collection using such devices will be in accordance manufacturer's instructions and groundwater sampling procedures described in Section 6.

4.3 Permanent Monitoring Well Construction

4.3.1 Overburden Wells Using Direct-push Drilling, Hollow-stem Augers, or Mud Rotary

All overburden monitoring wells will typically be installed using direct-push or hollow-stem auger drilling techniques. To install 4 1/4-inch (ID) hollow-stem augers will be used to install 2-inch wells, and 6 1/4-inch (ID) hollow-stem augers will be used to install 4-inch diameter wells. Macro-Core® sampling techniques (direct-push drilling) or split spoons (hollow-stem auger and mud-rotary drilling) will be used to collect soil samples for classification and laboratory analysis. Procedures for collection of soil samples are described in HRP SOP #'s 104, *Soil Sampling* and 105 *Soil Sample Collection for Volatile Organic Compound Analysis*. Additional information related to installation of monitoring wells in overburden materials is provided HRP SOP #102 *Overburden Monitoring Well Installation*. HRP SOPs are provided in **Appendix A**.

For wells designed to sample the shallow groundwater at and just below the water table (identified as "shallow wells"), monitoring wells will be constructed as indicated in the following paragraph. For wells screened at deeper depths in the aquifer, similar well construction techniques will be used, but the borehole depth will be dependent on the desired depth of the screened interval.

Once groundwater is encountered, the borehole will be extended an additional 5 to 7 feet into the saturated zone, depending on site-specific considerations such as amount of water-table fluctuation and timing of well installation relative to typical water levels in the aquifer, or to a depth as directed by the NYSDEC. Once the desired depth is reached, the inner bit will be removed, and the well material will be placed within the augers.

Monitoring wells will be constructed with a ten-foot section of 10-slot (0.01-inch) well screen, and the appropriate length of schedule 40 polyvinyl chloride flush-joint casing to ground surface. Once the well material has been set, the annulus space between the augers and the well screen will be backfilled with #0 Morie Sand or equivalent. Simultaneously with the installation of the sandpack, the augers will be retracted. The sandpack will be brought to 2 feet above the top of the screened interval. A two-foot-thick layer of bentonite chips will be placed on top of the sandpack and hydrated. The remaining annulus space will be backfilled with a cement/bentonite grout mixture. The augers will then be withdrawn and the grout within the borehole will be topped off as necessary.

Monitoring wells will be completed with a protective steel casing installed flush with the ground surface, or with a steel riser casing, depending on well location /or as directed by the NYSDEC representative. Each well will have a vented cap and a locking cover. A cement pad will be installed to channel surface water away from the well. A small hole will be drilled in the protective casing to allow any water between the inner and outer casing to drain. Well construction and installation will be completed in accordance with the specific well installation and construction procedures as described in the project-specific Work Plan.

For deeper overburden wells located in a geologic formation where hollow-stem augers would not be ideal, mud-rotary drilling techniques may be used. Mud-rotary uses a circulation fluid (typically drilling mud) which is pumped through the drill stem, out the bit, and up the annulus between the drill stem and the borehole wall. The mud runs through a de-sander at the ground surface, and then recirculated back down the drill stem. Soil samples can be collected at desired intervals using split-spoons sampling devices. Once the well is drilled to depth, the well casing will be placed in the open borehole. A tremie pipe will be placed at the bottom of the borehole and clean potable water will be circulated to thin out the mud. Once it is determined that there is no longer a presence of mud in the borehole, the monitoring well will be constructed as described above. All drilling fluids will be containerized and managed in accordance with applicable procedures described in DER-10 Section 3.3 (e) and applicable laws and regulations.

4.3.2 Bedrock Monitoring Wells

Drilling techniques and well construction details for bedrock wells must be addressed on a project-specific basis based on project-specific objectives, DQOs, and site-specific geologic and hydrogeologic characteristics. Specific procedures for the installation of bedrock monitoring wells will be described in detail in the project-specific Work Plan and as required to meet the specific objectives of the Work Assignment. However, a general example of the approach for drilling procedures used to advance boreholes for the construction of bedrock monitoring wells is provided in the following paragraph. Monitoring wells in bedrock will generally be constructed in a similar manner to those described for overburden wells, although project-specific considerations will be addressed in the project-specific Work Plan.

The installation of bedrock monitoring wells will use a combination of hollow-stem augering and rock coring/air-rotary drilling. The overburden material will be drilled to bedrock using 6-1/4 inch inside diameter (I.D.) hollow-stem augers. Split-spoon or Macro-Core® samplers will be used to collect soil samples for classification and sampling in the unconsolidated materials. Once bedrock is encountered, the inner bit will be removed and the hollow- stem augers will act as a temporary casing. If rock cores are to be collected, the bedrock will be NX or HQ cored to a site-specific depth below ground surface. Rock cores will be logged according to standard procedures that will be described in the project-specific Work Plan. If no rock cores are to be collected, a 3 5/8 inch-diameter air-rotary hammer will be used to advance the borehole to the desired depth.

4.4 Monitoring Well Decommissioning

Once it has been determined that monitoring wells are no longer needed at a site and there is no potential for re-use by another regulatory program, monitoring wells should be decommissioned. Decommissioning is also appropriate if the integrity of a monitoring well is known or suspected to be compromised. Since monitoring well construction varies considerably depending on the intended purpose and the local geologic and hydrogeologic conditions, decisions regarding the appropriate method to be used for decommissioning are site-specific in nature and must be made for each individual monitoring well. All decisions regarding the appropriate method for decommissioning of monitoring wells will be made in accordance with NYSDEC guidance CP-43, *Groundwater Monitoring Well Decommissioning Policy,* dated November 3, 2009, and the associated addendum, *Groundwater Monitoring Well Decommissioning Procedures,* dated August 2009.

5.0 MONITORING WELL DEVELOPMENT

All monitoring wells install at a site will be developed to purge any drilling fluids or sediment that may have entered the well through the filter pack and well screen during installation. Monitoring wells will be developed no sooner than 48 hours following installation. Monitoring wells will be developed using surging and pumping techniques to force the existing water and sediment back and forth through the screen and filter pack. Well development will be considered complete when temperature, conductivity, and pH have stabilized and a turbidity of less than 50 nephelometric turbidity units (NTUs) has been achieved. A well development/purge log will be used to record well development parameters and water-quality measurements. A copy of a well development/purge log is provided in **Appendix B**. Development water will be managed in accordance with provisions described in Section 3.3 (e) of DER-10, as described in Section 15 of this FAP, unless otherwise directed by the NYSDEC. If non-aqueous phase liquid or an odor is observed, or if directed by NYSDEC, the development water will be containerized, handled, and disposed of as described in Section 15.

6.0 GROUNDWATER MONITORING AND SAMPLING

Water levels and groundwater samples will be collected from temporary wells or screen-point sampling devices and permanent monitoring wells. Specific information regarding the groundwater monitoring and sampling program are provided in the project-specific Work Plan.

6.1 General Groundwater Monitoring and Sampling Procedures

Groundwater monitoring well sampling procedures will include water-level measurements, well purging, field measurements, and sample collection at each monitoring well location. A copy of the purging and sampling log form used to record well purging, water quality measurements, and sampling flow rates is provided in **Appendix B**. The objective of the groundwater sampling protocol is to obtain samples that are representative of the aquifer in the well vicinity so that analytical results reflect the composition of the groundwater as accurately as possible. Wells will be allowed to stabilize at least three days after development prior to collecting samples for analysis, depending on such conditions as the nature of the aquifer materials and turbidity at the conclusion of well development, unless directed otherwise by NYSDEC personnel. Specific details related to timing of groundwater sampling after well development will be provided in the project-specific Work Plan.

Prior to the start of a groundwater sampling event, water levels will be collected from the entire monitoring well network to prepare a groundwater contour map and evaluate groundwater flow patterns. If applicable, an oil/water interface probe will be used to measure product thickness (if any) in the groundwater monitoring wells.

Rapid and significant changes can occur in groundwater samples upon exposure to sunlight, temperature, and pressure changes at ground surface. Therefore, groundwater sampling will be conducted in a manner that will minimize interaction of the sample and the surface environment. The equipment and protocol for collecting groundwater samples by each method are described in Sections 6.2 through 6.4.

Groundwater samples will be analyzed by USEPA methods in accordance with the ASP for each sampling events.

6.2 Groundwater Sampling from Temporary Wells or Screen-point Samplers

In some cases, project-specific objectives may include the collection of screening-level groundwater data from temporary monitoring wells or sampling points or from direct-push screen-point sampling devices. Such screening-level groundwater samples will typically be collected from temporary sampling devices as grab samples using a bailer or similar grab-sample collection device or using a peristaltic pump and section of polyethylene tubing, in general accordance with procedures described in HRP SOP #107 Low-flow Groundwater Sampling, which is provided in **Appendix A**. Decisions regarding the specific groundwater sampling technique to be used for temporary wells or sampling points will be based on the project-specific DQOs and the selected methodology will be described in the project-specific Work Plan. Unlike sampling of permanent monitoring wells, screening-level groundwater samples may be collected immediately following installation of the well/sampling point or screen-point device.

Upon completion of sampling, boreholes associated with temporary groundwater sampling locations will be backfilled with bentonite and marked with a stake/flag that will be labeled with the proper location identification, and will be illustrated on the site map so it can be located at a later date. Borings performed in paved or concrete areas will be backfilled and refinished at the ground surface with concrete or cold patch.

6.3 Groundwater Sampling from Permanent Monitoring Wells

Unless otherwise specified or appropriate based on previous groundwater sampling events, HRP's default procedure for groundwater sampling will be to use low-flow groundwater sampling methods. HRP SOP #107 *Low-flow Groundwater Sampling*, which is provided in **Appendix A**, describes the low-flow sampling techniques that will be used for the majority of sites where groundwater sampling is performed. However, HRP recognizes that there may be circumstances for which other groundwater sampling techniques may be appropriate, for example, when groundwater monitoring at a site has already been conducted for a period of time using a different purging and sampling strategy. Example purging and sampling procedures for an alternative to low-flow groundwater sampling are provided in the following subsections.

6.3.1 Purging and Sampling Equipment

Well purging and sampling may be performed using the following:

- Submersible pumps, peristaltic pumps, and or dedicated polyethylene bailers to be used for well purging
- Electronic water-level measurement unit with accuracy of 0.01 foot
- Flow-measurement device (containers graduated in milliliters) and stop watch

PID instrument to monitor vapor concentrations during purging and sampling as required by the project-specific Health and Safety Plan (HASP).

6.3.2 Field Analytical Equipment

Field equipment to be used at the site will include individual or combination water-quality meters to measure pH, temperature, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen, and turbidity or using a flow-through cell that includes probes for measurement of pH, temperature, specific conductance, and ORP. Measurements of turbidity must be made on aliquots of the groundwater collected before water enters the flow-through cell; therefore, a separate turbidity meter will be necessary when a flow-cell is used for the other parameters. Additionally, a PID will be used to obtain a headspace reading at the well head upon opening the well. Each piece of field analytical equipment will be checked by HRP personnel to be in proper working order before its use and calibrated as required by the manufacturer. Field instruments used for groundwater sampling will be calibrated at the beginning of each day of groundwater sampling in accordance with the project-specific QAPP and as described in the HRP SOP #108 *Field Screening*, which is included in **Appendix A**.

Prior to use at each sampling location, field analytical equipment probe(s) will be decontaminated. After each use, the instrument will be checked and stored in an area shielded from weather conditions.

6.3.3 Sampling Procedures

As indicated in Section 6.3.1, groundwater samples will typically be collected from each well no sooner than three days following monitoring well installation and development, unless sampling within a shorter period would still meet project-specific DQOs, and such a time-frame for sampling is specified in the project-specific Work Plan and project-specific FAP, and has been approved by the NYSDEC Project Manager. Sampling will not be conducted less than 24 hours after well installation and development unless samples are intended to be used for screening purposes only.

The following procedures will be used for monitoring well groundwater sampling:

- Wear appropriate personal protective equipment as specified in the project-specific Health and Safety Plan (HASP) and the project-specific HASP Addendum. In addition, samplers will use new sampling gloves for the collection of each sample.

- Unlock and remove the well cap.

- Obtain PID readings and record them in the field logbook and well sampling log.

- Measure the static water level in the well with an electronic water-level indicator at least 15 minutes after the well has been opened to allow for stabilization of water levels. The water-level indicator will be washed with a solution of Alconox® or Liquinox® detergent and water, then rinsed with deionized water between individual wells to prevent cross-examination. Decontamination fluids will be containerized. Liquinox® will not be used if samples are to be collected for 1,4-dioxane analysis, since Liquinox® contains a small amount of the 1,4-dioxane.

- Calculate the volume of water in the well.

- Place sampling equipment on polyethylene sheeting or other clean surface (such as inside a plastic container) near the well casing to prevent potential contamination of sampling equipment due to contact with the ground surface. Special considerations for potential contact with the ground surface or inappropriate materials will need to be taken when sampling for per- and polyfluoroalkyl substances (PFAS), as described in Section 14 of this FAP.

The following procedures describe groundwater sampling procedures used when sample collection will be performed following the purging of three to five well volumes from the well. Procedures for low-flow groundwater sampling are described in HRP SOP #107 *Low-flow Groundwater Sampling*, which is included in **Appendix A**.

- Purge 3 to 5 well volumes of water from the well, using one of three methods described below. Purged water will be containerized separately from decontamination fluids.

  - ⇒ Bail with a dedicated, disposable polyethylene bailer.
  - ⇒ Pump with a centrifugal pump using new polyethylene tubing dedicated to each well. Set intake slightly below the surface level of the groundwater and start pump; continue to lower the intake line through the well to just above screen depth ensuring that all standing water in the well has been purged.
  - ⇒ Pump with a submersible pump equipped with: (1) a check valve to avoid backflush and (2) new polyethylene tubing dedicated to each well. Set intake at the surface level of the groundwater and start pump; continue to lower the intake line ensuring that all standing water in the well has been purged.

- Allow field parameters of pH, temperature, specific conductance, ORP, dissolved oxygen, to stabilize before sampling. Purging will be complete if the following conditions are met for three consecutive instrument readings:

  - ⇒ pH readings within ±0.2 pH units of each other
  - ⇒ water temperatures within ±0.5°C of each other
  - ⇒ Specific conductance within ±10 percent of each other.
  - ⇒ ORP is within ±20 millivolts
  - ⇒ Dissolved oxygen is within 10% of each other for values greater than 0.5 mg/l or if three consecutive readings are less 0.5 mg/l.
  - ⇒ Turbidity is less than 50 NTUs.

If these parameters (with the exception of ORP and dissolved oxygen when purging is conducted using a bailer) are not met after purging a volume equal to 5 times the volume of standing water in the well, the HRP Project Manager will be contacted to determine the appropriate action(s). Due to the nature of sampling groundwater using a bailer, it is possible than ORP and dissolved oxygen measurements could be affected by the sampling procedure, and therefore, the above values should be considered a goal, but not a requirement that would preclude sampling after 5 well volumes have been removed from the well using a bailer.

- If the well goes dry before the required volumes are removed, the well may be sampled when it recovers (recovery period up to 24 hours).

- Obtain sample from well with a bailer suspended on new, clean nylon twine. The sampling will be performed with a new bailer dedicated to each individual well.

- Collect the sample aliquot for VOC analysis first by lowering and raising the bailer slowly to avoid agitation and degassing, and then collect sample aliquots for the semi-volatile organic compounds analysis and carefully pour directly into the appropriate sample bottles. Sample bottles containing appropriate preservative for the parameter to be analyzed will be obtained from the laboratory.

- Obtain field measurements of pH, temperature, and specific conductance, ORP, and dissolved oxygen, and record measurements on the purging and sampling form. The instruments will be decontaminated between wells to prevent cross-contamination.

- Place analytical samples in cooler and chill to 4°C. Samples will be shipped to the analytical laboratories within 24 hours.

- If a centrifugal or submersible pump is used, it will be decontaminated between wells, and the polyethylene suction/discharge line will be properly discarded.

- Re-lock well cap.

- Fill out field logbook, sample log sheet, labels, custody seals, and chain-of-custody forms. Copies of applicable field forms are provided in **Appendix B**.

Groundwater samples will be placed in appropriate sample containers, sealed, and submitted to the laboratory for analysis. For each groundwater sampling event, groundwater samples will be analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol. The samples will be labeled, handled, and packaged following the procedures described in Generic Quality Assurance Project Plan (QAPP) and project-specific QAPP. Sample management procedures are further described in HRP SOP #106 *Sample Handling*, which is provided in **Appendix A**, and is included as an attachment to the QAPP. Quality assurance/quality control samples will be collected at the frequency detailed in the QAPP and project-specific QAPP, as well as the project-specific Work Plan.

Purge water will be managed in accordance with provisions described in Section 3.3 (e) of DER-10, as described in Section 15 of this FAP, unless otherwise directed by the NYSDEC. If non-aqueous phase liquid or an odor is observed, or if directed by NYSDEC, the purge water will be containerized, handled, and disposed of as described in Section 15.

7.0 EXPLORATORY TEST PITS EXCAVATION AND SAMPLING/TRENCHES

Based on data quality objects for a project, it may be determined that excavation of test pits is an appropriate subsurface exploration activity to observe in-situ conditions over a broader area than can be achieved from soil samples collected from one or more borehole. Test pits and trenching may also be appropriate to better identify areas of fill or subsurface disposal.

Appropriate locations and depths for test pits or trenches will be based on previous knowledge of contaminant distribution, as well as data gaps in understanding the distribution of geologic/hydrogeologic characteristics of the subsurface or contaminant distribution. Test pits/trenches will be excavated to appropriate depths and with various planar footprints, depending on objectives for observations and/or soil sampling.

Groundwater levels and leaching may be monitored to determine the actual location of the water table or if a perched water table is present, as well as approximate hydraulic conductivity of unsaturated zone soils. Head-space screening techniques, performed in accordance with procedures described in HRP SOP #108 *Field Screening*, will be used to identify the depths and locations to collect soil samples. Proposed trenching locations and specifications will be provided in the project-specific Work Plan. As indicated in the project-specific Work Plan, soil samples collected from each test pit/trench will be submitted for analytical testing.

Excavated soil will be managed in accordance with provisions described in Section 3.3 (e) of DER-10, as indicated in Section 15 of this FAP, unless otherwise directed by NYSDEC. If non-aqueous phase liquid is present or an odor is observed, or if directed by NYSDEC, the excavated soil will be containerized, handled, and disposed of as described in Section 15. Under most circumstances, it is anticipated that soil will be placed onto plastic sheeting on the site as excavation proceeds, and following soil sampling and any other data collection from the test pits, the excavated soil will be used to backfill the test pits/trenches (in more or less the same stratigraphic order as the in-place soils) or will be otherwise managed in accordance with procedures described in Section 3.3 (e) of DER-10.

Selected soil samples from the test pits/trenches will be analyzed by an approved ELAP-certified laboratory in accordance with the NYSDEC Analytical Service Protocol. All samples collected will be labeled, handled, and packaged following the procedures described in the Generic QAPP and project-specific QAPP, as well as HRP SOP #106 *Sample Handling*, which is provided in **Appendix A**. Quality assurance/quality control samples will be collected at the frequency detailed in the Generic QAPP, project-specific QAPP, and the project-specific Work Plan.

If the test pits/trenches are to remain open, they will be secured with fencing when personnel are not on the site. In addition, if water is encountered during the test pit/trench excavation, then a decision by the NYSDEC project manager will be made to cease the operation, fill in the test pit/trench, or possibly dewater the test pits/trenches. If the test pit/trench is dewatered, appropriate measures will be taken to ensure that the water will either be containerized or treated on-site before being disposed of with proper permits.

8.0 SURFACE WATER SAMPLING

Local surface water may or may not be affected by site hydrology or hydrogeology. If sampling of surface water is deemed appropriate for a site, such sampling will be designed and conducted in accordance with Section 3.8 of DER-10 and other applicable guidance to meet project-specific DQOs and to accomplish the overall project objectives.

Should surface water sampling deemed necessary, surface water sampling locations will be identified in the field prior to sampling using flagging or other suitable method to help ensure that field personnel perform sampling at the appropriate location. Should sampling at the planned location not be possible at the time of sampling, the sample location should be corrected with flagging to facilitate subsequently locating the actual sampling locations with a high-precision global positioning system (GPS) unit.

The names and addresses of property owners where the offsite surface water sampling is anticipated to occur will be provided to the NYSDEC Project Manager prior to sampling. The NYSDEC Project Manager will contact the property owners consistent with NYSDEC DER guidance to discuss the sampling program and schedule the sampling. The NYSDEC Project Manager will provide HRP with a copy of the correspondence and surface water sampling schedule.

Following identification of the surface water sampling locations, the appropriate approach for sample collection will be determined based on such factors as nature of the surface water body (width, depth, current, etc.) and viable sampling techniques to collect a sample that will meet project-specific DQOs. If the appropriate location for sample collection is determined to be from within the water body itself, field personnel will collect the sample by entering the surface water from a downstream direction to reach the desired sample location. Samples will be collected in successive order from most downgradient to most upgradient locations.

Surface water samples will be collected with a dipper, beaker, or pond sampler or other acceptable surface water sampling device that will collect samples in a manner that will accomplish project objectives in accordance with the DQOs. The number of samples collected and sampling locations, as well as any specific details regarding sample collection techniques or depth, will be provided in the project-specific Work Plan.

The approximate locations of each sample will be noted in the field logbook. To the extent practicable to meet project-specific DQOs, field measurements of pH, dissolved oxygen, temperature, and specific conductivity will be obtained and recorded in the field logbook. The field sampling crew will record visual observations (sample color, any unusual characteristics [odor, turbidity, etc.]) in the field notebook and on the field record of the surface water sampling. All instruments used in sample collection will be decontaminated between locations to prevent cross-contamination.

Surface water samples will be placed in appropriate sample containers, sealed, and submitted to the laboratory analysis. The samples will be labeled, handled, and packaged following the procedures described in the Generic QAPP and project-specific QAPP and HRP SOP #106 *Sample Handling*. Surface water samples will be analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol for the parameters indicated in the project-specific Work Plan. Quality assurance/quality control samples will be collected at the frequency detailed in the Generic QAPP, project-specific QAPP, and the project-specific Work Plan.

9.0 SEDIMENT SAMPLING

Sediment sampling is may be conducted in conjunction with surface water sampling, and many of the sampling procedure in this section are similar to those described in Section 8 (Surface Water Sampling). If sediment sampling is deemed appropriate for a site, such sampling will be designed and conducted in accordance with Section 3.8 of DER-10 and other applicable guidance to meet project-specific DQOs and to accomplish the overall project objectives.

Should sediment sampling be deemed necessary, sediment sampling locations will be identified in the field prior to sampling using flagging or other suitable method to help ensure that field personnel perform sampling at the appropriate location. Should sampling at the planned location not be possible at the time of sampling, the sample location should be corrected with flagging to facilitate subsequently locating the actual sampling locations with a high-precision global positioning system (GPS) unit.

The names and addresses of property owners where the offsite sediment water sampling is anticipated to occur will be provided to the NYSDEC Project Manager prior to sampling. The NYSDEC Project Manager will contact the property owners consistent with NYSDEC DER guidance to discuss the sampling program and schedule the sampling. The NYSDEC Project Manager will provide HRP with a copy of the correspondence and sediment sampling schedule.

The field sampling crew will examine the sediment samples and record visual observations (sample color, texture, any unusual characteristics [odor, staining, etc.]) in the field notebook and on the field record of sediment sampling. The instruments will be decontaminated between locations to prevent cross-contamination. As for surface water sampling, sediment sample collection will proceed from most downstream to most upstream location prevent potential disturbance of sediment at each sample location.

Surficial sediment samples (0 to 6 inches) will be collected using a clean, stainless steel coring device, a stainless steel hand auger, or a stainless steel scoop, as appropriate for the sediment conditions. Dedicated sampling equipment will be used to prevent cross-contamination and to minimize decontamination requirements.

Sediment samples will be collected using the following procedures:

1. Identify the proposed sample location in the field notebook along with other appropriate information collected during sediment sampling activities.
2. Don personal protective equipment (as required by the HASP).
3. At each sample location, deploy the sampling device as specified according to manufacturer's directions.
4. Once the sampling device has reached the appropriate depth for sediment sample collection, retrieve the device.
5. Open the sampling device to allow the sediments to empty onto a stainless steel tray.
7. Describe and record sample descriptions.
8. Package sediments in the appropriate containers.

Sediment samples will be placed in appropriate sample containers, sealed, and submitted to the laboratory analysis. The samples will be labeled, handled, and packaged following the procedures described in the Generic QAPP and project-specific QAPP and HRP SOP #106 Sample Handling. Sediment samples will be analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol for the parameters indicated in the project-specific Work Plan. Quality assurance/quality control samples will be collected at the frequency detailed in the Generic QAPP, project-specific QAPP, and the project-specific Work Plan.

10.0 SOIL VAPOR POINT INSTALLATION AND SAMPLING

The primary purpose of the soil vapor investigation is to further characterize and quantify the lateral and longitudinal extents of soil vapor contamination within the vadose zone. This information, in turn, provides a line of evidence with respect to potential source zones in soil and/or groundwater and footprints of VOC plumes in groundwater. The soil vapor data will also be used to evaluate the potential for vapor intrusion in structures located onsite, downgradient of the site, or adjacent to the sampling locations. Soil vapor investigations will follow the NYSDOH *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, October 2006, including any subsequently published updates.

Vadose zone monitoring can be used to develop subsequent site characterization activities such as installation of groundwater monitoring points. The vadose zone monitoring will be completed using an acceptable soil vapor methodology and will include the collection of quality assurance and quality control samples.

All soil vapor point locations will be flagged and labeled with the relevant sample location identification information that can be used by NYSDEC staff during a subsequent high-precision GPS survey.

10.1 Soil Vapor Point Installation

Soil vapor points will be installed using either hand-drilling techniques or Geoprobe®/direct-push drilling techniques to install soil vapor points.

Direct-push Installation Techniques

Stainless steel drive-points will be installed to a pre-determined depth appropriate for site-specific conditions. More than one depth per sampling location may be appropriate, depending on the DQOs for the soil vapor investigation. Soil vapor points will be installed no deeper than 1 foot above the water-table interface or the bedrock surface. Once the sampling depth is reached, the 6-inch stainless steel sampling screen is attached to a dedicated section of 0.25-inch diameter Teflon™ or Teflon™-lined tubing that is identified as laboratory- or food-grade will be installed and used to collect the soil vapor samples. For soil vapor sampling points that are to be left in place, the borehole will then be backfilled with sand to a minimum of 6 inches above the screened interval. Granular bentonite pellets will then be placed from approximately 6 inches above the screen to the ground surface, while concurrently hydrating with potable or distilled water during placement. Sufficient time will then be provided for the bentonite to set. Soil boring spoils will be managed as investigation-derived waste, as described in Section 15 and in Section 3.3 (e) of DER-10.

Hand-drilling Installation Techniques

Hand drills may be used to penetrate through a concrete (or other) surface to install soil vapor screen-point sampling devices. The soil vapor sampling screen-point will be attached to a dedicated section of Teflon™ or Teflon™-lined tubing that is identified as laboratory- or food-grade and will be used to collect the soil vapor samples. The vapor point will be filled with sand beads to a level that is less than one inch below the top of the floor surface. Modeling clay will then be placed around and into the soil vapor point at the ground surface. Any debris from the drilling cuttings will be swept up with a hand broom and disposed of in accordance with procedures described in Section 15.

Laboratory Analysis

Soil vapor samples will be analyzed by a laboratory certified by Environmental Lead Proficiency Analytical Testing (ELPAT) for VOC analysis of air samples using USEPA Method TO-15 (Table 1) or another appropriate analytical method based on project-specific DQOs, and specific in the project-specific Work Plan and QAPP. The proposed ELPAT-certified laboratory must be certified by the Environmental Laboratory Approval Program (ELAP) to perform USEPA Method TO-15 analysis. A minimum reporting limit of 1 microgram per liter (µg/m3) must be achieved for all VOCs.

10.2 Soil Vapor Point Sampling

Soil vapor samples will be collected in the same manner at all locations to minimize possible discrepancies. The following procedures will be strictly adhered to when sampling soil vapor:

- At least 24 hours after the installation of the temporary soil vapor points, 2 to 3 volumes of the sample probe and tube) will be purged prior to collecting the samples to ensure that representative samples are collected.
- Flow rates for both purging and collecting will not exceed 0.2 liters per minute to minimize outdoor air infiltration during sampling.
- Samples will be collected using conventional sampling methods and appropriate containers, which meet the objectives of the Work Assignment (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photo degradation), and meet the requirements of the sampling and analytical methods (e.g., low flow rate; SUMMA canisters, which are certified clean by the laboratory, using an appropriate USEPA method). The sample duration for these samples will be 2 hours or as designated in the Work Assignment.
- A tracer gas (e.g., helium, butane, or sulfur hexafluoride) will be used at each location before collecting soil vapor samples to verify that adequate sampling techniques are being implemented (i.e., to verify infiltration of outdoor air is not occurring).

When soil vapor samples are collected, the following actions will be taken to document local conditions during sampling that may influence interpretation of the results:

- Sample location will be noted, including the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor ambient air sample locations (if applicable), and compass orientation (north).
- Weather conditions (e.g., precipitation, outdoor temperature, barometric pressure, wind speed, and direction) will be noted for the past 24 to 48 hours.
- Any pertinent observations will be recorded, such as odors and readings from field instrumentation.

The field sampling team will maintain a sample log sheet (**Appendix B**) summarizing the following:

- Sample identification
- Date and time of sample collection
- Sampling depth
- Identity of samplers
- Sampling methods and devices
- Purge volumes
- Volume of soil vapor extracted
- Canister and associated regulator identification
- Helium leak test results
- Vacuum before and after samples collected
- Apparent moisture content (dry, moist, saturated, etc.) of the sampling zone
- Chain-of-custody protocols and records used to track samples.

After the sample collection period, the SUMMA Canisters will be sent for subsequent laboratory analysis. The soil vapor samples will then be analyzed for target constituents. The soil vapor samples will be analyzed by an approved ELAP-certified laboratory in accordance with NYSDEC Analytical Services Protocol. A minimum reporting limit of 1 microgram per cubic meter (µg/m3) will be achieved for all analytes unless otherwise directed by the NYSDEC or NYSDOH. Specific information related to sample collection and analysis will be in accordance with the project-specific QAPP and will be described in the project-specific Work Plan.

Upon completion of the sampling, the sample tubing will be removed and the temporary soil vapor point location will be backfilled with bentonite and marked with a stake/flag that will be labeled with the proper sample identification and illustrated on the site map so it can be located by the site surveyor. Borings performed in paved or concrete areas will be backfilled and refinished at the ground surface with concrete or cold patch.

11.0 INDOOR AIR MONITORING

Indoor air sampling programs will be conducted within structures and at locations within structures identified by NYSDEC and/or NYSDOH personnel. Protocols and methods used will be in accordance with the 2006 NYSDOH guidance (*Guidance for Evaluating Soil Vapor Intrusion in New York State* and subsequent updates) and discussion with NYSDEC and NYSDOH personnel, as appropriate. The overall goal of an indoor air sampling program is to evaluate the potential for vapor intrusion into these structures, and if vapor intrusion is identified, to evaluate appropriate remedial strategies to address the presence of contaminants in indoor air.

Notices of solicitation to participate in the indoor air monitoring program and scheduling appointments will be conducted by the NYSDEC and NYSDOH. Prior to initiating the air sampling, property owners will be contacted by NYSDEC consistent with NYSDEC guidance. The NYSDEC Project Manager will contact the property owners, discuss the sampling program and schedule the sampling. The NYSDEC Project Manager will provide HRP with a copy of the correspondence and indoor air sampling schedule.

11.1 Indoor Air Sample Collection

An inspection of general site conditions will be performed at each property location as part of the air sampling. The inspection will include the following activities:

- Completion of the NYSDOH Indoor Air Quality Questionnaire and Building Inventory included in *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*. A sample of the questionnaire will be provided in the project-specific Work Plan.
- Documentation of weather conditions outside and temperature inside.
- Ambient air (indoor and outdoor) screening using field equipment (i.e., photoionization detector with detection potential in parts per billion).
- Selection of air sampling locations.

At each location, air samples will be collected for laboratory analysis using an appropriate USEPA method, which will be identified in the project-specific QAPP and Work Plan. Air samples will be collected from three locations per structure including the first floor, basement, and the sub-slab environment. A section of Teflon™ or Teflon™-lined tubing that is identified as laboratory- or food-grade will be extended from the SUMMA canister to collect the ambient air sample from the breathing zone at approximately 3 to 5 feet above ground surface. An active approach, using laboratory batch-certified SUMMA canisters, regulated for a 24-hour sample collection, will be used to evaluate the indoor air and sub-slab soil vapor conditions.

11.1.1 Sub-Slab Sample Procedures

The following procedures will be used for all sub-slab sampling:

- Visually assess the condition of the floor. Select an area for sampling that is out of the line of traffic and away from major cracks and other floor penetrations (sumps, pipes, etc.).

- Drill a 3/8-in. diameter hole completely through the concrete floor slab using an electric hammer drill.
- Sweep concrete dust away from the drill hole and wipe the floor with a dampened towel.
- Insert the Teflon™-lined polyethylene tubing (1/4-inch inside diameter × 3/8-inch outside diameter, approximately 3 feet long) into the hole drilled in the floor, extending no further than 2 inches below the bottom of the floor slab.
- Pour inert backfill material (i.e., glass beads or clean sand) around the tubing, packing it around the tubing to fill the hole to the top of the ground surface.
- Place modeling clay around the soil vapor point at the ground surface to seal it, overlapping the borehole sufficiently to prevent ambient air from entering the borehole
- Attach a syringe to the sample tube and purge approximately 100 ml of air/vapor. The syringe will be capped and the air released outside the building so it does not interfere with the indoor air sample collection.
- Place a canister on the floor adjacent to the sample tube. The canister will be either a 6-L or 1-L canister (provided by an independent laboratory) with a vacuum gauge and flow controller. The canister must be certified clean in accordance with USEPA Method TO-15 and under a vacuum pressure of no more than -30 inches of mercury in HG. Flow controllers must be set for a 24-hour collection period.
- Record the serial number of the canister and associated regulator on the chain-of-custody form and field notebook/sample form. Assign sample identification on the canister identification tag and record this on the chain-of-custody form and field notebook/sample form. For the property owner's privacy, do not use a sample identifier containing the name of the property owner or the address of the property.
- Record the gauge pressure; the vacuum gauge pressure must read -25 inches Hg or less, or the canister cannot be used.
- Record the start time on the chain-of-custody form and on the air sampling form (provided in **Appendix B**), and take a digital photograph of canister setup and the surrounding area.

11.1.2 Termination of Sample Collection

- Close the canister valve; record the stop time on the chain-of-custody form and in the field notebook/sample form.
- Record the final gauge pressure and disconnect the sample tubing and the pressure gauge/flow controller from the canister, if applicable.
- Install the plug on the canister inlet fitting and place the sample container in the original box.
- Complete the sample collection log with the appropriate information, and log each sample on the chain-of-custody form.
- Remove the temporary subsurface probe and properly seal the hole in the slab with hydraulic cement.

Field quality control samples will include duplicates and trip blanks. Field duplicates will be collected at the rate of 1 duplicate per 20 original samples (5 percent). Field duplicates will be collected by installing an in-line "T" connection, which will essentially split the flow coming from the sample tubing penetrating the floor to 2 canisters set up adjacent to each other and each collecting vapors at identical flow rates. One trip blank will be analyzed and shipped to the laboratory with the final set of sample canisters.

11.2 Outdoor Air Sample Collection

In addition to the indoor air samples, outdoor ambient air samples will be collected. Ambient air samples will be collected during the same 24-hour period as the indoor air samples, which represent outdoor air conditions for the entire sampling area. The ambient air samples will be collected in a laboratory batch-certified SUMMA canister, regulated for a 24-hour sample collection. A section of Teflon™ or Teflon™-lined tubing that is identified as laboratory- or food-grade will be extended from the SUMMA canister to collect the ambient air sample from the breathing zone at approximately 3 to 5 feet above ground surface. Consistent with the indoor and sub-slab vapor sampling, the collecting rate of the outdoor air sample will be less than 0.2 L per minute. Outdoor ambient air samples will be collected at a minimum of one per day during the indoor air monitoring program. Based on scheduling and overall distribution of indoor air sampling locations, HRP and NYSDEC staff will determine if more than one ambient air sample is needed per day.

11.3 Laboratory Analysis of Air Samples

Air samples will be analyzed by an ELAP-certified laboratory. Detection limits for the analyzed compound list will be defined by the NYSDEC and NYSDOH prior to sample submittal and will be indicated in the project-specific Work Plan. For specific parameters identified by NYSDOH, where the selected parameters may have a higher detection limit (e.g., acetone), the higher detection limits will be designated by NYSDOH.

12.0 COMMUNITY AIR MONITORING PROGRAMS

12.1 Monitoring

Monitoring concentrations of volatile organic compounds (VOCs) and particulate levels at the perimeter of the work area in real-time is an important component of any project for which the public could be at risk due to the release of VOCs or particulates into ambient air during the performance of investigation and/or remedial activities. Such monitoring may include a combination of continuous and periodic monitoring, and design of such a monitoring program will be contingent upon site-specific field and construction activities. The monitoring program will be described in a project-specific Community Air Monitoring Plan (CAMP) that is developed for each site or project. Community air monitoring programs and procedures for VOCs and particulates will be conducted in accordance with procedures described in Appendix 1A (*New York State Department of Health Generic Community Air Monitoring Plan*) and Appendix 1B (*Fugitive Dust and Particulate Monitoring*) of DER-10.

12.1.1 Continuous Air Monitoring

Continuous monitoring for VOCs and particulates may be required for all intrusive activities associated with the site for which the ground is disturbed. Such ground-intrusive activities include soil/waste excavation and handling, excavation of test pits, and advancement of soil borings.

Monitoring of VOCs should be conducted at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified in the project-specific Work Plan and/or HASP. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a photoionization detector (PID) that is appropriate to measure the types and concentration range of VOC known or suspected to be present at the site. The PID shall be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The PID must be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified in Section 12.2. Should other contaminants not detectable using a PID, be present as a potential risk for air-borne dispersion, appropriate instrumentation to measure those contaminants will be specified in the project-specific Work Plan and HASP.

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the work area at temporary particulate monitoring stations. The particulate monitoring will be performed using a real-time particulate air monitoring instrument that is capable of measuring particulate matter less than 10 micrometers in size [PM-10] and capable of integrating over a period of 15 minutes for comparison to the airborne particulate action level. The particulate air monitoring instrument will be equipped with an audible alarm to indicate exceedance of the action level. In addition to using the particulate air monitoring instrument, fugitive dust migration will be visually assessed during all work activities. If particulate concentrations are recorded at higher or equivalent concentrations at the upwind station during investigation activities then continuous air monitoring will be discontinued, as approved by NYSDEC representative.

12.1.2 Periodic or "As-Needed" Air Monitoring

Periodic or as-needed air monitoring for VOCs may be required during non-intrusive activities associated with the project-specific Work Plan. Non-intrusive activities are anticipated to include the collection of soil and sediment samples, the collection of groundwater samples from existing monitoring wells, and the collection of indoor air and soil vapor samples. Periodic air monitoring during sample collection will consist of taking a measurement upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well bailing/purging, and taking a reading prior to leaving a sample location.

12.2 Action Levels and Response

This subsection identifies the typical action levels and corresponding responses for concentrations of VOCs and particulates detected during the field activities associated with a site. Project-specific monitoring procedures and action levels will be identified in the project-specific HASP, as well as the project-specific Work Plan and Community Air Monitoring Plan.

12.2.1 Volatile Organic Compounds

If the concentration of total VOCs at the downwind perimeter of the work area exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring will continue. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

If total VOC concentrations at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be stopped, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the work 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.

If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shut down.

All 15-minute readings will be recorded and be available for NYSDEC and NYSDOH personnel to review. Instantaneous readings (if any) used for decision purposes will also be recorded.

12.2.2 Particulates

If the downwind PM-10 particulate level is 100 micrograms per cubic meter ($\mu g/m^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 $\mu g/m^3$ above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, the downwind PM-10 particulate levels are greater than 150 µg/m^3 above the upwind level, work will be stopped, and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 µg/m^3 of the upwind level and in preventing visible dust migration.

Similar to the VOC readings, all particulate readings will be recorded and be available for NYSDEC and NYSDOH personnel to review.

13.0 PRIVATE WELL/TAP WATER SAMPLING

During the course of a site characterization or remedial investigation, it may be necessary or appropriate to conduct sampling of private water supplies to evaluate the extent of a contaminant plume and to evaluate the potential risk to public health due to the presence of contamination in an aquifer that supplies water to private water supplies. In such cases, a strategic sampling and analysis plan would be developed in coordination with NYSDEC and NYSDOH to accomplish the project-specific DQOs that are developed for the sampling effort and that take into account the conceptual site model for contaminant distribution in the aquifer and exposure pathways to the potential receptors through their private water supplies.

The approach for sampling private water supplies would include the activities described below that are applicable to most situations. Project-specific considerations and procedures would be described in a project-specific sampling and analysis plan for private water supply sampling, which would be presented in the project-specific Work Plan or project-specific Work Plan Addendum. Typical information that would be included in the project-specific sampling and analysis plan would include rationale and objectives for the sampling program, sampling locations, the numbers and types of samples that would be collected, sampling strategy, and QA/QC sampling that would be performed as part of the sampling program.

One item to be identified in the project-specific sampling plan would be the specific objective for the sampling of private water supplies. Generally, the objective would be to identify the presence and concentration of the specific contaminant(s) in the aquifer. In such cases, the intent would be to collect samples as close as possible to the entry of water into the house from the private well, since collection of samples from the well itself is generally not feasible. Occasionally, the objective could be to evaluate the quality of water that was actually being consumed, in which case, the samples would be collected at a commonly used tap (such as a kitchen tap) after passing through the water supply system for the house, including holding tanks, pipes and filtration systems. The purpose of such sampling would be to obtain a more realistic value of risk to the occupants of the dwelling. For the purpose of this section of the FAP, it is procedures to address the former objective that are described.

The following activities describe a general approach to sampling of private water supplies.

1. All private water supplies within the initially defined study area, as determined based on the conceptual site model, should be identified based on public records, and if, necessary, door-to-door or drive-by surveys. Determination of the initial study area should be made in coordination with appropriate NYSDEC and NYSDOH personnel.

2. Locations where sampling of private water supplies is to be conducted should be identified (if the initial sampling is to be a subset of all available private water supplies)

3. Available information related to well characteristics should be obtained from potential sources, such as local health departments, state records, local drillers, and homeowners.

4. The location where the water source first enters the structure should be examined for the possible presence of a pressure/holding tank and/or treatment system. Collection of a

sample prior to entry of water into a pressure tank is preferable to avoid contact with as much of the water distribution system as possible.

5. If sample collection is to be from an outside or basement tap or faucet, the sampling area should be free of excessive dust, rain, snow or other sources of contamination.

6. If collection of the water sample must be at a faucet, the space under the sink should first be examined to determine if a treatment system is present. If a system is present, then an alternative faucet without an “under-sink” treatment system should be located.

7. A cold water faucet will be used for sample collection. The faucet should be free of such features as aeration or purification devices (which, if present, must be removed prior to sample collection).

8. When collecting samples, care will be taken to ensure that the mouth of the sample container does not come into contact with the faucet.

9. Prior to sample collection, the faucet will be opened and the system flushed for a minimum of 5 to 15 minutes depending on the location of the sample-collection point relative to the entry point of water into the water system. For interior faucets, a longer flushing time may be appropriate if an expansion/holding tank is present. Depending on the objectives for the sampling effort, it may be appropriate to measure typical sampling parameters, such as pH and temperature to evaluate stabilization prior to sample collection. Such an approach would be included in the project-specific sampling and analysis plan.

10. After flushing, the rate of flow will be reduced to minimize agitation of the water sample during collection.

11. Samples will be collected into appropriate containers and preserved based on the analyses to be conducted, as described in the generic QAPP and project-specific QAPP.

12. Collection of QA/QC samples for each sampling event will be described in the sampling and analysis plan that is included as a component of the project-specific Work Plan. At a minimum, QA/QC sampling will include one duplicate sample for every 20 samples collected and one trip blank per cooler per day if analysis for VOCs is included in the sampling and analysis plan.

13. Sample management following collection will be in accordance with procedures described in the generic QAPP and project-specific QAPP, and as described in HRP SOP # 106 *Sample Handling* (provided in Appendix A).

14.0 PFAS SAMPLING AND ANALYSIS AND 1,4-DIOXANE ANALYSIS

14.1 Per- and Polyfluoroalkyl Substances

Protocols for the collection and analysis of water samples for per- and polyfluoroalkyl substances (PFAS) will be in accordance with the most recent NYSDEC and NYSDOH guidance. Knowledge of PFAS is rapidly evolving, which will require HRP to stay current with respect to sampling and analysis of these compounds, so the general procedures identified in this FAP will be reviewed and updated on a regular basis. Specific procedures to be used for any Work Assignment will be provided in the associated project-specific Work Plan.

In general, sampling procedures will in accordance with appropriate protocols for the type of sample being collected, i.e., groundwater from monitoring wells (as described in Section 6 of this FAP) or water from private water supplies (as described in Section 13), unless otherwise directed by NYSDEC and/or NYSDOH. Low-flow groundwater sampling methodology will be used for sample collection from monitoring wells. However, certain procedures must be modified due to the presence of PFAS in multiple types of products that could result in contamination of water samples collected without taking precautions to eliminate or minimize the presence of outside influences on concentrations found in the samples collected. The following paragraphs provide a general summary of prohibited and acceptable materials for use during sampling for PFAS.

Sampling Considerations

Specific materials that are prohibited for use when sampling for PFAS include pumps and tubing containing Teflon® and other fluoropolymer-containing materials. Acceptable materials for pumps, tubing, and other sampling equipment include: peristaltic or stainless steel pumps and high-density polyethylene (HDPE) or silicone tubing. Additional materials for sampling equipment may be acceptable, but such requests must be preapproved by NYSDEC, and requests to use alternate equipment will include results from equipment blanks indicating that PFAS were not detected.

Equipment blanks will be generated at a rate of at least once per day. Decontamination, if needed for sampling equipment, will be performed using solutions of Alconox® or Liquinox® in potable water, followed by rinsing with deionized water (Liquinox® will not be used if sampling for 1,4-dioxane is to occur, since Liquinox® contains a small amount of 1,4-dioxane).

For sample collection and equipment storage, containers and equipment will not contain or come in contact with aluminum foil, low-density polyethylene (LDPE), glass, polytetrafluoroethylene (PTFE) (including PTFE- or Teflon™-lined caps for sampling containers). Chemical ice packs will not be used. Pre-cleaned sample bottles with closures, coolers, ice, sample labels, and a chain of custody form will be provided by the laboratory. Deionized water for QA/QC blanks will also be supplied by the laboratory, and natural ice will be used to maintain a temperature of 4^0 C ± 2^0 prior to delivery to the laboratory.

Clothing or boots made of or with PTFE material (including GORE-TEX® or other synthetic water resistant and/or stain resistant materials, or Tyvek® material or that have been waterproofed with PFAS materials) will not be worn on the day of sampling. All clothing worn by sampling personnel must have been laundered multiple times.

Because some personal care products are known to contain PFAS, cosmetics, moisturizers, hand cream and other related products will not be used on the day of sampling. However, if it can be demonstrated that a product does not contain PFAS, use of those products will be acceptable for use if approved by the NYSDEC project manager.

Some products typically used for field documentation will not be used for field documentation during PFAS sampling events due to the potential for PFAS in the materials. Such materials include waterproof/treated paper or field books, plastic clipboards, non-Sharpie® markers, Post-It® notes, and other adhesive paper products. Plain paper, metal clipboards, Sharpies®, and pens will be used for field documentation. The laboratory will be responsible for supplying chain-of-custody forms that meet acceptable criteria for PFAS sampling.

Since many food and drink packaging materials contain PFAS, pre-packaged food and fast food wrappers or containers will be prohibited from the site and the field vehicle. However, bottled water or hydration drinks will be allowed.

Sampling Activities

Samples will be collected for PFAS analysis in a similar manner to samples collected for analysis for other types of constituents in accordance with the sampling procedures identified below.

- The sampler must wear nitrile gloves while filling and sealing the sample bottles. New nitrile gloves must be used for each sampling location.
- Samples for PFAS analysis will be collected first, prior to collecting samples for any other parameters into any other containers to avoid contact with any other types of sample containers, bottles, or package materials, and sampler should not handle other sampling equipment or bottles after donning the nitrile gloves until after the sample for PFAS analysis has been collected and stored for transport.
- As for all other samples, the sample bottle cap will not be placed on any surface when collecting the sample and the sampler will avoid all contact with the inside of the sample bottle or its cap.
- Once the sample is collected and capped with an acceptable cap and liner closure system, the sample bottle(s) will be labeled and placed in the shipping container/cooler packed only with ice to be maintained at 4 ± 2° Celsius until delivery to the laboratory.
- One equipment blank and one field duplicate sample will be collected for every sample batch at a rate of no less than one equipment blank and one field blank for every 20 samples. In addition, one matrix spike/matrix spike duplicate (MS/MSD) sample will be collected for analysis for every sample batch with the same sample collection frequency of one per 20 field samples, or more frequently if the sampling batch contains samples with significantly different characteristics.

Laboratory Analysis

Based on currently available information and the need to achieve low reporting limits for PFAS, Modified USEPA Method 537 will be used to analyze for PFAS in groundwater. Expectations are that using this method, a reporting limit of 2 ng/L can be achieved for each of the compounds on the target analyte list indicated in the following table. Laboratories will be required to provide the appropriate data deliverable (Category A or B) for the site in the specified electronic data deliverable format.

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	PFUAlPFUdA	2058-94-8
	Perfluorododecanoic acid	PFDoA	307-55-1
	Perfluorotridecanoic acid	PFTriAlPFTrDA	72629-94-8
	Perfluorotetradecanoic acid	PFTAlPFTeDA	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
Perfluorooctanesulfonamides	Perfluroroctanesulfonamide	FOSA	754-91-6
Perfluorooctane-sulfonamidbacetic acids	N-methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
	N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6

14.2 1,4-Dioxane Sampling and Analysis

Analysis for 1,4-dioxane will be conducted at least once for all sites where chlorinated solvents are constituents of concern, unless otherwise directed by DER personnel. Sample collection for 1,4-dioxane analysis will be in accordance with standard sample collection procedures depending on the type of sample collected (e.g., groundwater from monitoring wells or drinking water from private wells). Standard QA/QC samples will be collected specifically to ensure that DQOs for QA/QC sampling are met for 1,4-dioxane analysis.

Both USEPA Methods 8260 and 8270 can be used to detect 1,4-dioxane, but the methods must be run using the "selective ion monitoring" (SIM) mode to achieve the required reporting limits. In accordance with DER guidance, the method detection limit for 1,4-dioxane will be no higher than 0.28 µg/l. DER has recommended use of USEPA Method 8270, because, among other reasons, that method is generally less likely to be affected by interference from chlorinated solvents. Therefore, all samples collected for 1,4-dioxane analysis will be analyzed using Method 8270 in SIM mode, unless otherwise instructed by DER personnel.

15.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

HRP is responsible for the proper storage, handling, and disposal of investigative-derived waste; including personal protective equipment, and solids and liquids generated during the well drilling, well development, and well sampling activities. All drummed materials will be clearly labeled as to their contents and origin. All investigative-derived waste will be managed in accordance with NYSDEC-DER-10 Section 3.3(e). As indicated in that section, transport, storage and disposal of investigation-derived waste is generally subject to one or more solid or hazardous waste regulations (e.g., 6 NYCRR Parts 360, 364 and the 370 series), unless specific regulatory exemptions are applicable.

The following summary of procedures that will be used by HRP for handling and disposal of investigation-derived waste for investigation and remediation projects has been developed based on the information provided in DER-10 Section 3.3 (e). The summary is not intended to be a reiteration of the information provided in that section of DER-10, rather it provides an overview of the considerations that will be taken into account in the storage, handling, and disposal of investigation-derived waste during the performance of investigation and remediation activities. In all cases, management of investigation-derived waste will be in accordance with DER-10 Section 3.3 (e), or as otherwise directed by NYSDEC personnel, and applicable laws and regulations.

As indicated in DER-10, Section 3.3(e), soil generated during the advancement of soil borings from on-site locations is presumed to be contaminated. Therefore, such soil will initially be stored on protective sheeting as boreholes are advanced during a drilling program. At the end of the day, any soil remaining on the plastic sheeting (i.e., not otherwise managed in accordance with provisions indicated below) will be covered with plastic sheeting that is secured from wind and precipitation pending subsequent disposition in accordance with DER-10 guidelines.

Soil that is not obviously contaminated based on visual, olfactory, or instrumental evidence or contain separate-phase NAPL may be returned to the borehole from which it originated, unless 1) the borehole is to be used for installation of a monitoring well or other monitoring device, 2) has penetrated an aquitard or confining layer, or 2) has extended into bedrock. If soil is returned to the borehole, it may not extend to within 12 inches of the ground surface (or within 24 inches at a residential site), and the borehole area must be restored to ground surface level as indicated in DER-10. If backfilling into the borehole could create a preferential pathway for vertical migration of contaminants, the backfilled soil will be mixed with bentonite to reduce permeability. Any soil that cannot be returned to the borehole for any of the reasons indicated above will be containerized, properly labeled, and sampled for disposal characterization and managed in accordance with DER-10 Section 3.3(e) 3.

Soil brought to the surface from off-site locations not known to be contaminated will be staged on plastic sheeting during borehole advancement, but will be containerized and returned to a pre-determined drum storage are on the site at the end of each day of drilling activities. Obviously contaminated soil generated during borehole advancement will be containerized as soon as possible after generation, but no later than completion of the borehole to the intended depth. As indicated in DER-10 Section 3.3(e), soil generated from borehole advancement at off-site locations is considered to be “non-contaminated” unless visual, olfactory, or instrumental evidence indicates otherwise or if such soil contains separate-phase NAPL. Therefore, “non-contaminated” soil will be backfilled into the boring from which it was generated, as indicated above for soil from on-site borings. Any non-contaminated soil that does not fit into the borehole as backfill will be containerized at the end of the day's activities and returned to the site. Containerized soil will be managed on the site as indicated in DER-10 Section 3.3(e) 3.

Soil removed from the subsurface during the excavation of test pits will generally be handled in the same manner as soil removed from a borehole. As the test pit is being excavated, removed soil will be placed on plastic sheeting. If no drums, NAPL, or other obvious contamination is observed, the soil will be placed back into the excavation after activities associated with the test pit have been completed (i.e., visual observation and logging, soil sampling, etc.). As soil is being placed back into the test pit, efforts will be made to replicate the general location and vertical distribution of the soil prior to removal from the test pit. Drums or containers encountered in the test pit will be containerized or over-packed, and obviously contaminated soil, including NAPL-contaminated soil or NAPL liquid will be containerized and managed as indicated above for soil from boreholes.

Any investigation-derived waste that is liquid will be managed as described in DER-10 Section 3.3(e) 5, and in accordance with all applicable laws and regulations. All such water and/or other liquid will be will be containerized as it is produced. Containers of water or other fluid generated as a result of well development or well purging prior to sampling will be properly labeled and securely staged in a designated area on the site pending appropriate disposition on the site or at an off-site disposal facility consistent with applicable guidance and regulations depending on contents of each container of liquid. With approval by DER personnel, containerized water may be discharged to unpaved ground surface within the source area and groundwater unit. If a remedial treatment system is operating on the site, the containerized water may be added to the treatment system.

In some cases, sediment entrained in containerized liquid may settle out of the liquid and accumulate in the containers of liquid investigation-derived waste. Such sediment will be managed as described in DER-10 Section 3.3(e) for solid material.

Investigation-derived waste soil and liquid that is generated from known areas of contamination must be characterized to ensure that the materials are properly labeled upon generation and must be classified with respect to the type of waste, so appropriate treatment and disposal options can be determined. All investigation-derived waste that is classified as either a solid or hazardous waste will be managed in accordance with applicable waste management regulations. Specific locations and procedures for storage and management of wastes will be identified in the project-specific Work Plan.

In addition to subsurface media, additional investigation-derived waste includes the generation of such wastes as 1) liquids as a result of equipment decontamination, 2) concrete dust from interior investigation activities and concrete chip sampling, 3) personnel protective equipment and clothing, and 4) general trash and debris. Those materials will be managed and disposed of as indicated below.

- Liquids generated from contaminated equipment decontamination procedures that exhibit visual staining, sheen, or discernible odors will be collected in drums or other containers at the point of generation. The containers will be properly labeled and securely stored in the designated waste-container staging area. Following sampling and waste characterization, a licensed waste disposal company will be contracted to remove the drums for disposal at an offsite disposal facility. Decontamination liquids that do not exhibit evidence of contamination will be containerized separately from those exhibiting evidence of contamination.

- Concrete dust generated during penetration through concrete floors or pads for the subsequent advancement of soil borings or other sampling activities, including collection of concrete chip samples, will be collected in shop vacuums and disposed of as non-regulated solid waste, unless photoionization detector readings or visual indications of contamination are noted during field operations, in which case disposal will be based on the results of sampling and analysis for waste characterization.
- Used protective clothing and equipment that is suspected to be contaminated with hazardous waste will be placed in plastic bags, packed in 55-gallon ring-top drums, and transported to the drum staging area for subsequent disposal as appropriate based on the nature of the contaminants present. Non-contaminated protective clothing will be packed in plastic bags and placed in a trash dumpster for disposal by a local waste removal company.

All drums containing investigation-derived waste, as well as used protective clothing and equipment, will be properly secured and staged in an appropriate location on the site. Coordination of the handling, labeling, and on-site storage of such drums, including sampling for characterization of contents and making arrangements for off-site disposal, will be the responsibility of HRP field personnel.

16.0 SITE SURVEY AND BASE MAP PREPARATION

For any site investigation or remedial action program, accurate plotting of key site features and sampling locations on site plans is an important component of the data evaluation and decision-making process. Therefore, HRP will conduct an instrument survey of site features that will include providing locational data for all soil boring locations, monitoring well locations, test pit locations, soil vapor point locations, and surface water/sediment sampling locations; performing a topographic survey and preparing a site map (typically based upon a previous base map or site control markers). To ensure the collection of consistent elevation data, each of the existing monitoring wells or other pertinent locations will be included in the site survey.

HRP will locate all field sampling locations using a high-precision GPS unit, survey equipment, and/or licensed surveyor, as directed by the NYSDEC project manager or as indicated in DER-10. In addition to providing the data for monitoring well locations, each monitoring wells will be surveyed with respect to elevation to an accuracy of 0.01 feet relative to a known site datum. A topographic survey and preparation of a site base map will be performed by a licensed professional land surveyor, if required by the NYSDEC project manager.

A detailed topographic base map of the site and immediate vicinity will be developed using the site survey data and applicable available mapping. All relevant features of the site and adjacent areas will be surveyed and included on the site plan. As previously noted, HRP will be responsible for placing either survey flags or survey stakes at each of the pertinent locations. The base map will be used to accurately plot all sampling locations, including soil borings, monitoring wells, and all other sample/monitoring locations on the site plan.

The site map will also include site-specific features associated with the characterization/investigation (i.e., surface water drainage, above and underground storage tanks, buildings, drywells, septic systems). Additionally, engineering controls implemented or to be implemented at the site must be clearly labeled. Contours will be plotted at 1-foot intervals. The location and elevation of each survey point will be surveyed by a New York State licensed surveyor. The elevations of all monitoring well casings will be established to within 0.01 feet based on the North American Vertical Datum (NAVD) of 1988. A permanent reference point will be placed in all interior polyvinyl chloride casings to provide a point to collect future groundwater elevation measurements.

All data collection for the site survey and details regarding base map preparation, as well as the preparation of other maps and plans prepared for the site, will be in accordance with the expectations presented in DER-10 guidance or as directed by the NYSDEC Project Manager.

For each site, the tax maps will be reviewed, and the property lines of the parcels will be plotted on the base map. The site tax map number will also be identified.

With respect to the site survey and base map preparation, the following assumptions have been made:

- The estimated survey area should include the whole site boundary. All elevations will be referenced to the NAVD 88. All horizontal locations will be referenced to the North

American Datum of 1983 (NAD83).

- Three blueline copies of the site base maps with topography (1-foot contour intervals), and three blueline copies of the site basemap, without topography, will be submitted to NYSDEC.
- The site map will be provided in AutoCAD® and ArcMap using versions of the software approved by NYSDEC.

17.0 REFERENCES

HRP, August 2019. *Generic Quality Assurance Project Plan for Work Assignments*. Prepared by HRP for NYSDEC.

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NYSDEC. 2009. *CP-43: Groundwater Monitoring Well Decommissioning Policy*, November 3, 2009.

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NYSDEC. Technical Procedure Guidance, Equipment Training, Calibration, and Maintenance, *Spill Guidance Manual*, Section 2.2.

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USEPA. 2017. *Standard Operating Procedure Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity)*, USEPA, Region 1, Quality Assurance Unit, Revision Number 3, Revised March 23, 2017.

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APPENDIX A

HRP Standard Operating Procedures

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Soil Boring Advancement

SOP #101

Revision Date: August 8, 2019

LIST OF REVISIONS

Date	Summary of Changes	Approval
	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

Technical Director/
HRP Quality Assurance Officer

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August 8, 2019
Date

Vice President/
Practice Leader - Environmental

Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

1.0 Introduction

This Standard Operating Procedure (SOP) discusses procedures and techniques for advancing soil borings either for exploration, soil sampling, or the installation of monitoring wells. The HRP representative should be aware that the drillers are responsible for the operation and safety of the drilling rig itself, but it is the responsibility of the HRP representative to ensure that proper procedures are used with respect to sampling and decontamination of equipment. This document was prepared in general accordance with ASTM methods D6282 / D6282M-14, *Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations*; D1452-16, *Practice for Soil Investigation and Sampling by Auger Borings*; and D1586-14, *Test Method for Penetration Test and Split-Barrel Sampling of Soils*. Procedures used to collect soil samples for chemical screening and/or subsequent laboratory analysis are provided in HRP SOP # 104*, Soil Sampling*.

2.0 Equipment - General

Equipment supplied by HRP for activities associated with the advancement of soil borings using hollow-stem auger or direct-push drilling techniques typically includes:

- Stainless steel spatula or alternative for splitting samples
- Portable Photoionization Detector (PID) instrument for sites where volatile organic compounds (VOCs) are a concern
- Polyethylene plastic sheeting or alternative technique
- Sample collection containers (glass jars, etc.)
- Indelible marker
- Two 5-gallon buckets
- Decontamination brushes
- Decontamination solutions/equipment
- Cooler with ice and/or cold packs
- Sample labels
- Field logbook and appropriate field forms
- Personal Protective Equipment, including clean disposable gloves, hard hat, steel toe shoes, hearing protection, and other equipment required by the site-specific Health & Safety Plan
- Clipboard
- Water-level tape with audible alarm
- Chain-of-Custody forms
- Paper towels

2.1. Drilling Rig

Unless otherwise specified, all soil borings will be installed using hollow-stem auger equipment or a Geoprobe® Macro-Core® sampler or similar device powered by an appropriate rig.

2.2. Water

Water is occasionally required to maintain the stability of the boring or specific drilling procedures. If water is used, the source(s) and estimated quantity will be recorded in the drilling log. Only a potable water supply may be used for drilling purposes.

2.3. Central Auger Bit Plug

In order to maintain clean, accurate samples, no hollow-stem auger drilling may be conducted without the use of a central auger bit plug. The driller should be made aware of this prior to entering the site, as is necessary.

3.0 Cleaning and Decontamination

Prior to advancing a soil boring, the HRP representative will ensure that all necessary equipment is clean and decontaminated, including the rig, all augers, rods and bits and other downhole equipment, samplers, brushes, and any other tools or equipment. Decontamination procedures may vary slightly from those presented below, dependent upon the particular types of contaminants encountered.

a. Decontamination supplies:

- solution of Alconox™ or Liquinox™ and water prepared in a 5-gallon bucket (approximately 2.5 gallons). Another 5-gallon bucket will contain potable water (approximate 2.5 gallons).
- Deionized water
- 5-gallon buckets
- Spray bottles
- Brushes
- Paper towels
- isopropyl alcohol/water solution (as appropriate based on contaminants and analyses to be performed)
- <10% nitric acid/water solution (as appropriate based on contaminants and analyses to be performed)

b. Sampling devices (typically split spoons or Macro-Core®-type sampling devices) will be decontaminated between each sample. The order of decontamination solutions and procedures for split-spoon and other multi-use sampling devices is as follows:

Decontamination in the following order:

- Wipe or scrub excess dirt from equipment, as needed, using brush or paper towels
- Rinse/scrub in potable water (in a 5-gallon bucket) to remove additional loose debris, as necessary

- Wash in a solution of Alconox™ or Liquinox™ and potable water (in a 5-gallon bucket)
- Rinse with potable water
- Rinse with analyte-free water
- *The following steps may be required by the QAPP, by regulatory agency, or necessary due to the nature of the contaminants*
- Spray with <10% isopropyl/water solution when organics are potential constituents of concern
- Rinse with potable water
- Rinse with <10% nitric acid/water solution when metals are potential constituents of concern
- Rinse with potable water
- Rinse with deionized water
- Wipe with a clean paper towel (optional, depending on weather conditions)
- Air Dry (as appropriate)

Alternative methods of cleaning may more appropriate (or necessary) for an individual pieces of equipment, based on site conditions, site contaminants, Quality Assurance Project Plan (QAPP), or site-specific work plan requirements, Alternative decontamination solutions must be consistent with overall objectives for the project, and use of alternative decontamination solutions or decontamination procedures must be made after consultation with the HRP project manager and must be documented in field paperwork as to rationale and appropriateness. Decisions regarding alternative decontamination procedures or solutions must be made in coordination with the HRP Project Manager and/or Quality Assurance Officer for the project.

c. At the end of the project day, all HRP equipment which is used on the site shall be decontaminated. Disposal of all spent decontamination solutions shall be in accordance with the requirements of the site work plan and state and federal requirements.

4.0 OSHA

The Foreman or Supervisor of the drilling crew shall be the "Competent Person" as required by OSHA for all work. However, to the best of his or her ability, the HRP representative should bring to the “Competent Person’s” attention conditions which may be unsafe or present a hazard to the drilling crew, the general public, or other workers on the site.

The HRP representative has stop-work authorization to be exercised upon determination of an imminent health or safety hazard. The project manager will be contacted immediately after a stop-work order is executed.

5.0 VOC Monitoring

If the potential exists for VOCs to be a concern at the site, a portable PID shall be available on site and shall be used to screen all cuttings and fluids (if any) removed from the borehole, and to screen the breathing zone in the working area for VOC levels.

6.0 Soil Boring Advancement

6.1. Rig Operation

a. Rig operation is the responsibility of the drilling crew Foreman or Supervisor.

b. The HRP representative will review utility locations with the drilling foreman prior to drilling and will bring to the attention of the drilling foreman and rig operator the requirements for sampling, health and safety, identified utility restrictions, decontamination procedures, and well construction specifications, as appropriate.

c. It is the responsibility of the drilling Foreman or Supervisor to ensure that the rig, upon arrival on-site, is in good working order; that all required equipment and supplies are present; and that the rig is free of loose debris, oil leaks, or defective equipment.

6.2. Field Screening

The procedure to obtain a PID reading for a soil sample is described in an attachment to HRP's SOP # 104, *Soil Sampling*.

6.3. Disposal of Potentially Contaminated Materials

Potentially contaminated cuttings or fluids, as indicated by knowledge of the site, discoloration, PID readings, or other evidence shall be disposed of in accordance with the requirements of the HRP site-specific Work Plan, QAPP, and applicable state and federal regulations.

6.4. Refusal

When drilling through unconsolidated materials using a hollow-stem auger drilling rig, the term "refusal" is generally defined as the failure of an approximate 2-inch diameter split-spoon sampler to penetrate more than one-tenth of a foot with 100 blows using a 140-pound hammer dropped from a height of 30 inches. However, refusal can also be designated at the discretion of the HRP representative if the Macro-Core® or similar sampler cannot advance using the standard operating procedures for the direct-push drilling rig by the rig's manufacturer.

6.5. <u>Bedrock</u>

a. The term "bedrock" will not be used in a boring log or other description unless a minimum of three (3) feet of bedrock core is recovered using an appropriate core drill, and in the opinion of a competent geologist, the core exhibits the characteristics of known bedrock in the region.

b. The terms "apparent bedrock" or "possible bedrock" may be used in a boring log at the judgment of the HRP representative, even if 3 feet of bedrock has not been cored, provided there is reasonable justification for such a conclusion.

6.6. <u>Other</u>

Depending on the specific site, other considerations may be applicable. Consult the site-specific work plan and health and safety plan (HASP) for details.

7.0 Logging Procedures for Soil Borings

a. The following information shall be recorded on the boring log:

- Project name, site location, and HRP job number.

- Boring identification number, borehole diameter, boring location on the site, drilling method, contractor, groundwater observations, the logger's name and the date.

- Depth below grade, sample I.D. number, identification numbers for duplicate samples, PID reading, number of blows required for each six-inch penetration of a 2-inch split spoon using a 140-pound hammer, rig behavior (i.e. drilling effort, etc.).

- A complete sample description, including at a minimum: depth of the sampling interval, depth of significant changes in lithology, material size and gradation, color, moisture, density, physical evidence of contamination, and any unusual odors. Procedures for describing subsurface materials may vary depending on the purpose of the sampling effort (i.e., hydrogeologic properties, lithologic description, geotechnical characteristics). In addition to HRP SOP #103 *Soil Logging and Description Using a Modified Burmister Classification System*, ASTM Standard D2488-90 "Practice for Description and Identification of Soils (Visual-Manual Procedure) and ASTM Standard D2487-92 "Classification of Soils for Engineering Purposes (Unified Soil Classification System)" may be consulted for additional information on describing soils, especially the latter if soil description for engineering purposes is needed.

- The use of water for drilling purposes, if any, including source(s) and estimated quantities.

8.0 Soil Sample Retrieval

8.1. Split-Spoon Sampling

a. Samples of unconsolidated materials are collected with a split-spoon sample device operating inside of and in advance of hollow-stem augers. However, if split-spoon sampling is not possible for an interval, other methods for collecting a sample may be employed based on the discretion of the HRP representative.

b. In general, the hollow-stem augers and the central auger bit plug shall be advanced to the depth of the sampling interval.

c. After removing the central auger bit plug, the split-spoon sampler will be lowered into the augers. It will then be driven up to 24 inches into the soil using a 140-pound hammer with a fall of 30 inches. The HRP representative will record the blows for each six-inch increment.

d. The spoon shall be opened by the driller. The HRP representative may assist in opening the split spoons, at his or her discretion.

e. At a minimum, the HRP representative will record on the boring log a description of the material in the sampler (material gradation, lithology, color), blow counts, depth of penetration below grade, PID instrument reading, percent or amount of recovery, moisture, density, physical evidence of contamination, and odor (if any).

f. Prior to reuse, the sampler shall be decontaminated.

g. Soil samples collected for archival purposes shall be placed into clean soil jars and labeled with the boring number, sample collection depth, date and job number. Additional labeling requirements may be specified in the site-specific work plan and/or QAPP.

h. The procedures for collection of soil samples for chemical analysis are described in HRP SOP for Soil Sampling.

8.2. Soil Sampling from a Macro-Core®

a. In general, the Macro-Core® cutting shoe and sampling tube shall be advanced by applying the static weight of the rig and/or a hydraulically-powered rotary hammer.

b. The stainless steel sampling tube shall be opened by the driller by unscrewing the cutting shoe and removing the 48" or 60"- liner of suitably inert material. The HRP representative may assist in opening the sampling tubes, at his or her discretion.

c. The HRP representative will record on the boring log a description of the material in the sampler (material gradation, lithology, color), percent or amount of recovery, depth of penetration of sampler below grade, PID instrument reading, moisture, density, physical evidence of contamination, and odor (if any) in accordance with

HRP SOP # 103, *Soil Logging and Description Using a Modified Burmister Classification System*.

d. Prior to reuse, the Macro-Core® sampler shall be decontaminated. The liners are not suitable for re-use and must be disposed of properly after samples have been collected.

e. Soil samples collected for archival purposes shall be placed into clean soil jars and labeled with the boring number, sample collection depth, date and job number. Additional labeling requirements may be specified in the site-specific work plan and/or QAPP.

f. The procedures for collection of soil samples for chemical analysis are described in the HRP SOP for Soil Sampling.

8.3. Sampling from Auger Flights

In cases where an insufficient amount of sample is available from the split spoon, collection of a sample from an auger flight may be appropriate. However, the utility of this sample is limited because an accurate measurement of the depth where the soil originated and the degree of mixing with other soil are not known. Samples taken from an auger flight may not be used for VOC analysis, except for screening purposes. The limitations of this type of sample should be carefully considered before submitting an auger flight sample for laboratory analysis. Auger flight samples can be collected using two methods.

1. A sample of the drill cuttings can be collected as the soil is extruded onto the ground (after rotation of the drill stem has stopped); or

2. A sample can be collected directly off the augers (after rotation of the drill stem has stopped) by removing a portion or all of the drill stem from the ground.

Typically, the closer the sample can be collected to the cutting bit when using Method 2, the greater the ability to estimate the depth of sample origin.

9.0 Abandonment of Soil Borings

a. If the boring is not to be used for other purposes (i.e., monitoring well, soil vapor probe, soil vapor extraction well, etc.), it shall be abandoned following completion and collection of samples for screening and/or laboratory analysis.

b. In general, the procedure for boring abandonment is as follows:
For most borings, bentonite chips or drilling tailings (spoils) should be used for backfill, either of which should be compacted during the backfilling operation. If drilling spoils are used, then they should be free from any evidence of contamination, unless site-specific work instructions specify otherwise based on project-specific data quality objectives. In all cases, backfilling of boreholes must be consistent with state and federal regulations and guidelines and specific

details regarding backfilling will be provided in site-specific work plans or work instructions.

If there are confining layers present in a boring and the presence of DNAPL is suspected, the boring shall be filled and sealed as the augers are withdrawn with cement-bentonite grout. If no confining layers were noted in a boring and the presence of DNAPL is not suspected, bentonite pellets or chips may be used, preferably as the augers are withdrawn. The pellets or chips should be compacted during the backfilling operation.

Well abandonment regulations vary from state to state. All monitoring wells will be abandoned if no longer needed in accordance with the regulatory requirements of the state where the work is performed.

c. In paved areas, when bentonite chips or grout is being used, the upper one to two feet of the borehole shall be filled, up to two inches below the existing grade, with sand to allow for repair of the pavement, concrete, or other surface material.

d. Asphalt pavement shall be repaired using cold-patch asphalt filler, unless otherwise specified in the site-specific work plan; concrete surface will be repaired with concrete; all other surfaces will be repaired as appropriate to be consistent with the surrounding surface.

10.0 Soil Boring Location Records

Following completion of the soil boring, its location in relation to known mapped features should be recorded for future reference using either taped measurements from two identified locations or surveyed relative to site features.

11.0 References

ASTM International. 2014. Standard Guide for Direct Push Soil Sampling for Environmental Site Characterizations, ASTM D6282 / D6282M-14.

ASTM International. 2016. Standard Practice for Practice for Soil Investigation and Sampling by Auger Borings, ASTM D 1452-16.

ASTM International. 2018. Standard Practice for Test Method for Penetration Test and Split-Barrel Sampling of Soils, ASTM D1586-18.

New York State Department of Environmental Conservation (NYSDEC). 2010. "DER-10, Technical Guidance for Site Investigation and Remediation", Division of Environmental Remediation. May 2010.

U.S. Environmental Protection Agency (US EPA), Region 4. 2015. Operating Procedure: Field Equipment Cleaning and Decontamination. SESDPROC-205-R3. Science and Ecosystem Support Division. Athens, GA.

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Overburden Monitoring Well Installation

SOP #102

Revision Date: August 8, 2019

LIST OF REVISIONS

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	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

Technical Director/
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Gail L. Batchelder

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August 8, 2019
Date

Vice President/
Practice Leader – Environmental

Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

1.0 INTRODUCTION

The purpose of this document is to describe methods for installing monitoring wells and piezometers within an overburden aquifer. Additional guidance for monitoring well installation includes ASTM Standard D5092/D5092M-16 *Standard Practice for Design and Installation of Ground Water Monitoring Wells*.

2.0 EQUIPMENT AND MATERIALS

2.1 Equipment Supplied by Driller

2.1.1 Drilling Rig

- Well Casing
- Bottom Cap
- PVC Well Cap
- Sand
- Bentonite
- Cement-Bentonite Grout
- Protective Casing

2.1.2 Above-grade well completion

- Steel pipe with locking cover, diameter at least 2 inches greater than well casing, painted with epoxy paint for rust protection,
- Heavy duty lock;
- Protective posts, if appropriate

2.1.3 Flush-mount well completion

- Steel road box with a cover and drain, diameter at least 4 inches greater than the well casing,
- rubber seal to prevent leakage

3.0 WELL CONSTRUCTION

While determining the desired depth of a monitor well, the stratigraphy of the location and the nature of the contaminants should be considered. Completion of a well screened across aquifer materials of varying hydraulic properties should generally be avoided if possible.

This section provides general practices for monitoring well construction when no other state or federal guidance exists that requires more stringent procedures. However, in all cases, monitoring well construction should be in accordance with applicable state and federal regulations and guidelines applicable to the location where the well is installed. Alternative well construction procedures and specifications should be described in the site-specific work plan or work instructions.

Monitoring wells will be constructed in the borehole, once the borehole has been advanced to the desired depth. If the borehole has been drilled to a depth greater than that at which the well is to be set, the borehole will be backfilled with bentonite pellets or a bentonite-cement slurry to a depth approximately 1 foot below the intended well depth. Calculating the depth to which the grout should be placed must take into account the amount of swelling by bentonite pellets once they have absorbed water within the saturated zone. Approximately 1 foot of clean sand will be placed on top of the bentonite to return the borehole to the proper depth for well installation after sufficient time has elapsed for the grout to set (generally overnight) or the bentonite pellets to absorb water. Measurements should be made of the depth to bentonite before calculating the amount of sand to add to the borehole and to better assess an accurate depth to which the well screen will be set.

All well construction materials should be delivered to the site wrapped in plastic. If not, such materials should not be used.

The appropriate lengths of well screen (with bottom cap) and casing will be joined watertight and lowered inside the augers to the bottom of the borehole. If centering guides are used, they will be placed at intervals around the well casing, beginning no lower than 5 feet above the top of the well screen.

Selection of the filter pack and well screen for the permanent shallow monitoring wells are based upon the gradation and grain size of site aquifer materials. Unless the sand pack and well screen slot size is determined using well design methods such as those described in ASTM Standard D5092M-16- a No. 0 or No. 1 sand (or similar) and a 10-slot well screen should be used. For wells screened in low-permeability formations, a No. 0 sand is more appropriate to avoid difficulties with turbidity during well development and subsequent groundwater sampling. It is also appropriate to use pre-packed well screens with No. 0 or a mixture of No. 0 and No. 00 sand, especially with finer silt and clay aquifers.

A sand pack consisting of clean silica sand will be placed around the well screen. The sand will be placed into the borehole at a uniform rate, in a manner that will allow even placement of the sand pack. The augers will be raised gradually during sand pack installation to avoid caving of the borehole wall; at no time will the augers be raised higher than the top of the sand pack during installation. During placement of the sand, the position of the top of the sand will be periodically sounded using a stainless steel weight attached to a fiberglass tape measure. The sand pack will be extended from the bottom of the borehole to a minimum height of 1 to 2 feet above the top of the well screen. Heights of the sand pack and bentonite seal may be modified slightly in the field to account for either a shallow water table and/or a limited saturated aquifer thickness.

A bentonite pellet seal at least 2 feet thick will be placed above the sand pack. The pellets will be placed into the borehole in a manner that will prevent bridging. The position of the top of the bentonite seal will be verified using a weighted tape measure. If all or a portion of the bentonite seal is above the water table, clean water will be added to hydrate the bentonite. Above the bentonite seal, a sand pack will be placed. At the discretion of the project manager, and if there is sufficient room, a second bentonite seal can be placed approximately 3'-5' below grade. The sand pack is extended to the appropriate depth for proper completion of the well.

For monitoring wells completed deep below the water table, or in a lower distinct aquifer separated from a shallow aquifer by an aquitard, an annular seal of cement-bentonite grout must be placed above the bentonite seal above the screened interval. If this option is selected, the cement-bentonite grout will be installed continuously in one operation from the bottom of the space to be grouted to the ground surface through a tremie pipe. The tremie pipe must be plugged at the bottom and have small openings along the sides of the bottom 1-foot length of pipe. This will allow the grout to diffuse laterally into the borehole.

For monitoring wells that will be completed above-grade, a locking steel protective casing set in a concrete pad will be installed. The steel protective casing will extend at least 3 feet into the ground and 2 feet above the ground. The concrete pad will be square, approximately 2 feet per side and should extend to a minimum of 6 inches below grade. The concrete pad will be sloped away from the protective casing.

Guard posts may be installed in high-traffic areas for additional protection. Four steel guard posts would be installed around the protective casing, within the edges of the concrete pad. Guard posts would be concrete-filled, at least 3 inches in diameter, and would extend at least 2 feet into the ground and 3 feet above the ground.

For monitoring wells completed flush with the ground surface, a steel road box with a rubber-sealed cover and drain will be installed. The top of the road box cover will be positioned approximately ½ to 1 inch above grade to allow for installation of the concrete pad. A square concrete pad, approximately 2 feet per side, will be installed as a concrete collar surrounding the road box cover, flush with surrounding grade and will slope uniformly downward in the same direction as the adjacent grade. The road box and installation thereof will be of sufficient strength to withstand normal vehicular traffic.

Concrete pads installed at all wells will extend to a minimum of 6 inches below grade. Protective casing, guard posts, and flush mounts will be installed into similar concrete pads, or one large concrete pad.

Each well will be properly labeled on the exterior of the locking cap or protective casing with a metal stamp indicating the permanent well number.

4.0 WELL DEVELOPMENT

For newly installed wells, the wells must be developed or a minimum of six well volumes should be removed prior to sampling. Well development is intended to remove excess sediment in the new well that may interfere with analytical results for groundwater samples. Development consists of pumping the well or surging and pumping the well until the water removed appears clear.

For removal of 6 times the standing volume in a 2-inch diameter well, 1 gallon of water should be bailed or pumped for every 1 foot of water column. A bucket of known volume can be used to collect and record the amount of groundwater purged by the bailer or pump method. When a mechanical pump is used for purging, the purging device should withdraw groundwater from mid-screen level, either by placing the pump intake at a depth equivalent to the middle of the wetted screen section, or by extending enough dedicated tubing such that the end of tubing is at a depth equivalent to the middle of the wetted screen section. Evacuation should continue until:

- the column of water in the well is free of visible sediment, and pH, temperature, turbidity, and specific conductivity have stabilized.
- A minimum of six well volumes are removed; or
- If well is purged dry, the water table should be allowed to sufficiently recover (to the static water level) before the next development period is initiated, and a minimum of six well volumes have been removed

The volume of water purged from the well can be determined using the following equation:

$$V = [(0.041)d^2](h)$$

Where:

V = Volume in gallons
d = Diameter of well in inches
h = Depth of water in feet (i.e., height of the standing water column)

The volume determined from this equation is the volume of water in the well. For a 2-inch diameter well, a general rule is that 1 gallon of water removed per foot for 6 times the volume of water in the well).

5.0 REFERENCES

ASTM International. 2016. Standard Practice for Design and Installation of Ground Water Monitoring Wells. D5092/D5092M-16.

ASTM International. 2018. Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers. ASTM D5521/5521M-18.

New York State Department of Environmental Conservation (NYSDEC). 2010. "DER-10, Technical Guidance for Site Investigation and Remediation", Division of Environmental Remediation. May 2010.

USEPA. 2013. *Design and Installation of Monitoring Wells,* USEPA Region 4, Science and Ecosystem Support Division, SESDGUID-101-R1, January 29, 2013.

HRP Associates, Inc.

STANDARD OPERATING Procedure
for

Soil Logging Using a Modified Burmister System

SOP #103

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LIST OF REVISIONS

Date	Summary of Changes	Approval
	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

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August 8, 2019
Date

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August 8, 2019
Date

The Modified Burmister Soil Classification System (Burmister System) was developed as a rapid field method for identifying and classifying soil and sediment. The system is based upon visual identification of the generalized grain-size distribution and description of the physical characteristics of the sample.

1.0 General Guidelines for Soil Description

The modified Burmister System to be used for describing soil is comprised of three parts: a color descriptor; a grain-size descriptor; and modifier(s). The color descriptor indicates the overall color or colors of the wet sample. The descriptor consists of a color name or names and (if possible) the color code from a standard color reference (for example, a Munsell Color Chart for soil). The grain-size description indicates the predominant grain size in the sample, as well as the relative percentages of other grain sizes present.

Modifiers are used to further describe the geologic character of the sample. Modifiers may include descriptions of moisture content, sorting, sphericity, angularity, sedimentary structures or other pertinent information. Additional information on soil classification is provided in ASTM Standard D2488-17, *Practice for Description and Identification of Soils (Visual-Manual Procedure)* and ASTM Standard D2487-17*, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)*.

1.1 Color Descriptor

The color of the wet soil or sediment should be determined with reference to a standard color comparator (a Munsell Color Chart, for example) for rocks or sediment. The color descriptor should contain both the color name and, when a color comparator is used, the appropriate hue-chroma value code, for example "Reddish brown (5YR 4/4)". The color of a sample should always be gauged when the sample is wet, or it should be noted otherwise.

1.2 Predominant Grain-size Descriptor

The second part of the soil description consists of a visual estimate of the range of grain sizes resent and the percentage of various grain sizes in the sample, with particular attention paid to the dominant grain size, since the primary grain-size descriptor indicates the predominant grain size, as judged visually, of the sample. The predominant grain size is always capitalized and underlined. Possible descriptors include: CLAY, SILT, SAND, and GRAVEL (GRANULES, PEBBLES, COBBLES, and BOULDERS). These correspond to the standard Wentworth size-classification scheme that is used for describing soil and sediments for geological purposes. If soil samples are to be described for geotechnical purposes, the Unified Soil Classification System should be used. Classification of soil under the Unified Soil Classification System is described in ASTM Standard D2487-17, *Classification of Soils for Engineering Purposes (Unified Soil Classification System)*. Additional information on soil classification is provided in ASTM Standard D2488-17, *Practice for Description and Identification of Soils (Visual-Manual Procedure)*. A comparison of common grain-size scales is provided in Attachment A-1.

Size classifications using a modified Burmister system for grain sizes ranging from clay through boulders are provided in the chart entitled, “Wentworth Scale for Grain-size Classification” and “Grain-size Scales and Characteristics” (Attachments A-2 and A-3). The descriptor should also include an indication of the relative size range of the sample within the predominant grain size (for example, "fine-to-medium sand", "coarse sand", etc.). Although the chart includes divisions of the silt category, this is applicable only to soil samples analyzed by pipette or hydrometer and therefore, such distinctions cannot be used for field descriptions.

The presence of other grain sizes, in addition to the predominant grain size is also included in the grain-size descriptor. Grain sizes used are the same as for the predominant grain size of the soil or sediment sample (clay, silt, etc.); however, only the initial letter of the word is capitalized. The description should also include an indication of the relative amount of the minor components. Appropriate indicators to describe the relative percentages are provided in the table entitled, “Grain-size Percentage Descriptors for Modified Burmister Soil Classification System” (Attachment B-1).

It is generally not considered possible to visually distinguish between clay and silt. Estimation of the silt/clay content of a sample should be based upon the plastic properties of the sample. The plastic properties of the sample may be estimated by taking an approximately 1 cubic centimeter ball of the sediment and attempting to roll a thread of the material between the palms of the hand. The minimum size of the thread that can be rolled may be compared to the values presented in table entitled, “Plasticity of Soil Samples” (Attachment B-2) and the degree of plasticity can be estimated. A comparison of the minimum thread diameter which may be formed with the information presented in that table provides an approximate estimate of the silt/clay content for sand-silt-clay soil and sediments and composite clay sediments.

1.3 Modifiers

Various modifiers may be added to the basic sediment description to further describe the geologic character of the sample.

For sand or coarser-sized material, the relative degree of sorting, the sphericity, and angularity should also be recorded. Sorting may be visually estimated. However, sphericity and angularity should be estimated with reference to an accepted comparator. Two charts illustrating various degrees of sphericity and angularity are provided in the figure entitled, “Roundness and Sphericity” (Attachment B-1).

The mineralogy of the sample should also be recorded. Reference should be made to the relative percentages, grain size(s), and sphericity of the mineral particles (especially where it differs significantly from that of the predominant grain-size material).

Other information that should be recorded for each sample includes an estimate of the density and cohesiveness of the sample (estimated from blow counts or other specific instrumentation, as appropriate), the relative moisture content of the sample, visible sedimentary structures, and any odors or staining noticeable during logging. Appropriate terms for describing the density and cohesiveness of soil samples are provided in the table entitled, “Density and Cohesiveness of Soil Samples” (Attachment B-1), and terms for plasticity are provided in the table entitled, “Plasticity of Soil Samples” (Attachment B-2).

Especially important to include in any description is an indication that a specific portion of the material may represent “sluff” or material collapsed from the borehole walls.

Also important to include in the description on the boring log is an indication as to moisture content. Although this can be subjective and not always obvious in certain types of soil, simply an indication of “dry”, “moist”, or “wet”, with such qualifiers as “very” or “slightly” or gradational descriptions such as “moist (top 10’’) to wet” should be noted on the boring log.

2.0 Written Soil Descriptions for Boring Logs

The written sediment description may be made as either an unabbreviated or an abbreviated description. Both methods should relate the same information. However, the abbreviated description may be easier for some people to use in the field.

In an unabbreviated description, all of the words used in the description should be written out in their entirety. The descriptor should include pertinent information regarding the grain-size distribution, color, consistency, etc., as described previously. The color descriptor should precede the name of the primary soil component and then additional components, while such details as plasticity, mineralogy, visible sedimentary structure, etc., should follow the soil component name.

Below is an example of an unabbreviated description:

- red-brown (5YR 4/4), fine-to-coarse SAND, little fine Gravel, little Silt, moist, moderately well sorted, low sphericity, Sand subangular, micaceous, moist

- Note: If a Munsell color chart is not available, the specific, numeric color descriptor would not be included.

The Burmister system is intended to provide a means for describing uniform soils and sediments; therefore, three "special" cases should be addressed.

1) The Burmister system is intended only to describe soil and sediment. When a genetic classification with respect to the origin of the material is significant and may aid in distinguishing specific changes in the subsurface that might be relevant to overall interpretations for the project, such an interpretation should be added as a separate statement at the end of the description and should ***only be used when the origin of the material is very clear*** and not simply a field interpretation of possible depositional environment. Including such a genetic interpretation can create significant problems at a later date if the field interpretation is not correct.

   It is standard practice not to include such an interpretation, with the exception that the word “Fill” may be added to a description if it is clear in field samples that the soil is not native, in-place material.

2) In the case where the soil sample is heterogeneous (for example, a varved silt and clay), each component should be described individually, and the nature of the heterogeneity and any interlayering should also be described. Reference should be made to the relative percentages of each component. An example of such a description is provided below.

Soft, reddish-brown (5YR 3/4), CLAY and SILT, alternately layered, medium to high overall plasticity. Layers: CLAY layers, 3/8" to 5/8" thick, comprise 60%" of sample. SILT layers, 1/8" to 3/8" thick, comprise 40%" of sample. VARVED CLAY and SILT

This in another example for which a genetic interpretation may be added to the description, provided that the person logging the soil is familiar with what constitutes "varved silt and clay", such as that found in Glacial Lake Hitchcock sediments.

3) When one material grades uniformly into another distinct soil type or grain size, the individual components should be described separately and the gradation noted. An example is provide below:

- reddish-brown (5YR 3/4), CLAY, medium overall plasticity, grading into soft,
- reddish-brown (5YR 4/4), SILT, trace Clay, low overall plasticity, soft, wet.

In the abbreviated sediment descriptions, the sample information is presented in a manner analogous to that for the unabbreviated description, but standard abbreviations are substituted for specific portions of the text. Abbreviations for the identifying terms in the Burmister system are presented in the associated tables. Mineralogic and geologic abbreviations may be found in standard geologic and mineralogic texts and field manuals. Except for the use of abbreviations, the abbreviated description is completely analogous to the unabbreviated description.

To maintain consistency in the way soils are described on boring logs, the various elements included in a soil sample description should follow the order in which those elements are presented in the table entitled, "Description of Soil Properties" (Attachment C). That table also provides specific information as to what each element of the soil description should include and how it should be presented.

3.0 References

ASTM International. 2017. *Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).* ASTM D2487-17.

ASTM International. 2017. *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. ASTM D2488-17.

Burmister, Donald M. 1950. *Principles and Techniques of Soil Identification*, Proceedings of the Twenty-Ninth Annual Meeting of the Highway Research Board Held at Washington, D.C. December 13-16, 1949, Highway Research Board Proceedings, Volume 29, December 1950.

Scientific Engineering Response and Analytical Services. 2004. *Description and Identification of Soils, Standard Operating Procedure #2074*. February 23, 2004.

ATTACHMENT A

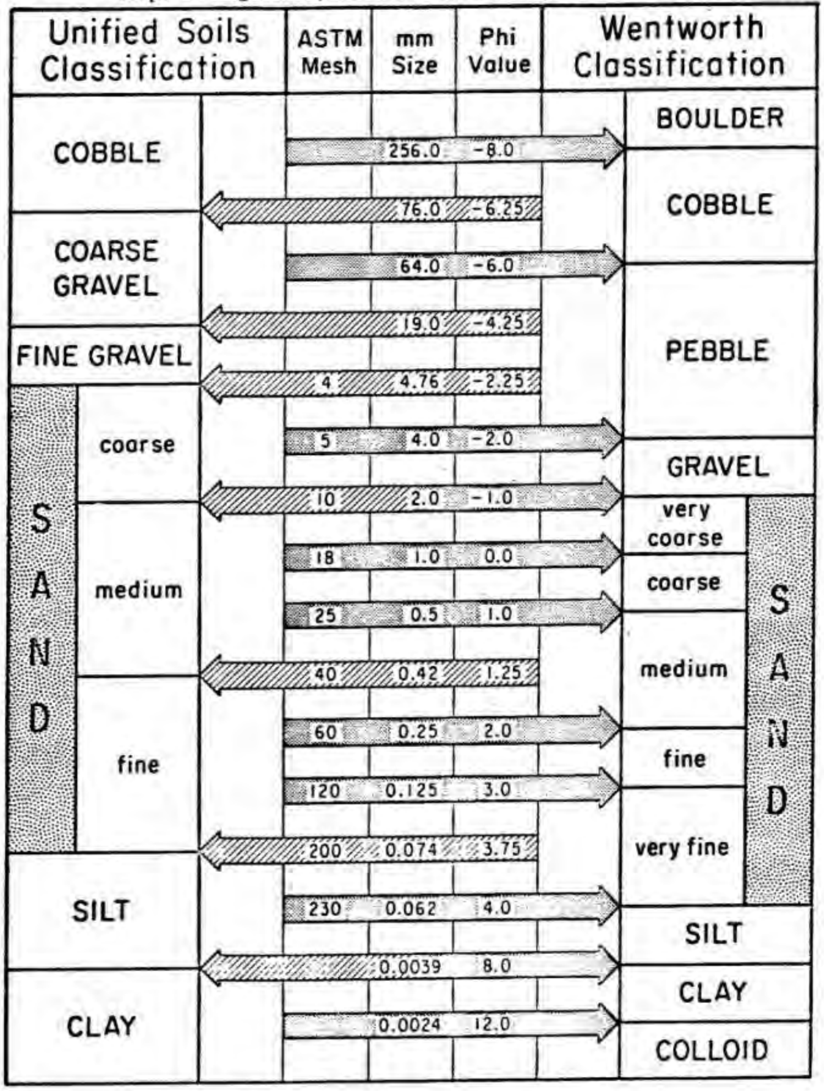
A-1 Comparison of Grain-size Scales for Unified Soil Classification System and Wentworth System

A-2 Wentworth Scale for Grain-size Classification

A-3 Grain-size Scales and Characteristics

Comparison of Grain-size Scales
for Unified Soil Classification System and Wentworth System

Grain-size scales--soil classification (modified from U.S. Army, Corps of Engineers, Coastal Engineering Research Center, 1977).

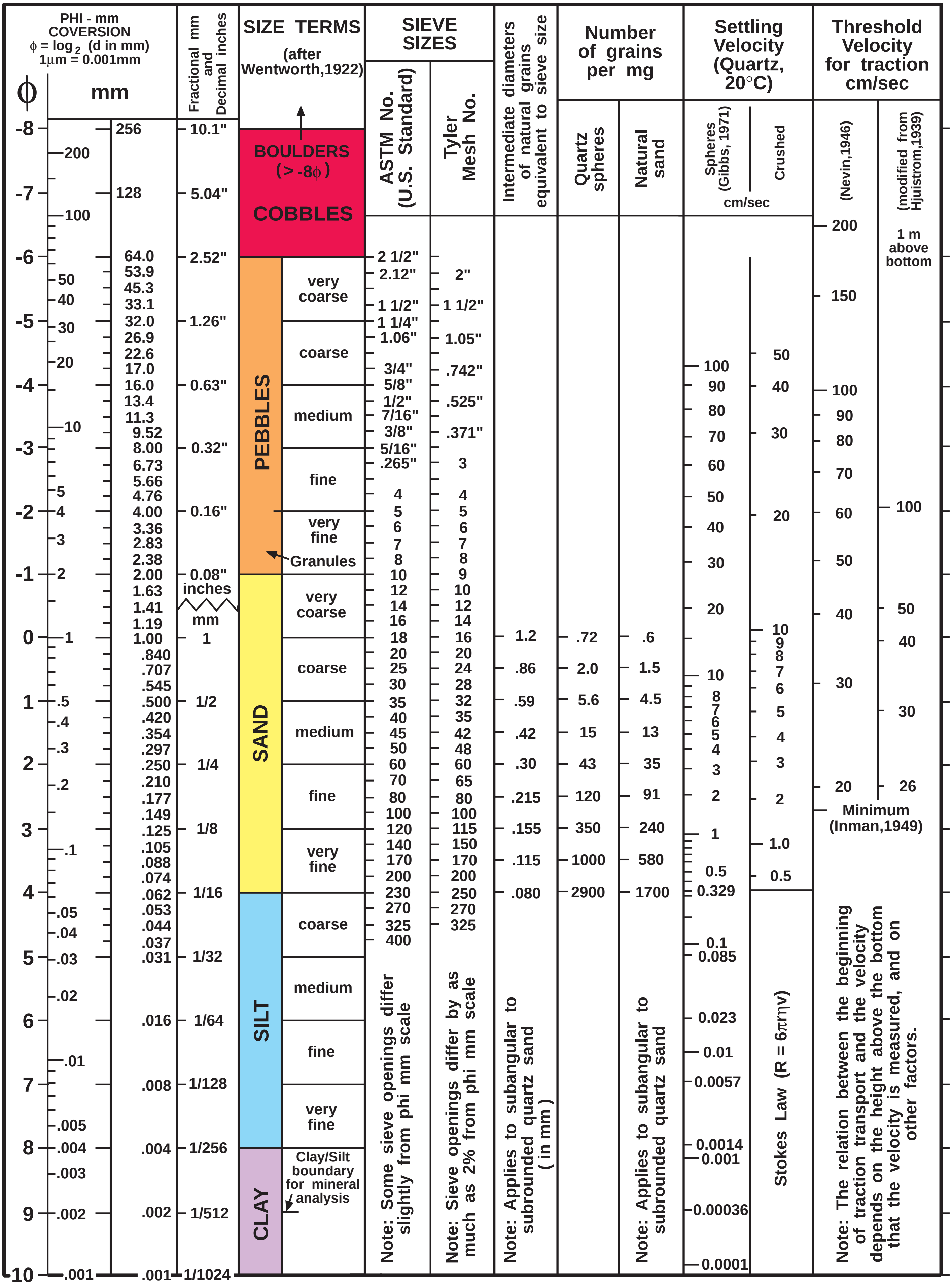


Unified Soils Classification		ASTM Mesh	mm Size	Phi Value	Wentworth Classification	
COBBLE					BOULDER	
			256.0	-8.0		
					COBBLE	
			76.0	-6.25		
COARSE GRAVEL						
			64.0	-6.0		
					PEBBLE	
			19.0	-4.25		
FINE GRAVEL						
		4	4.76	-2.25		
SAND	coarse					
		5	4.0	-2.0		
					GRAVEL	
		10	2.0	-1.0		
	medium				very coarse	SAND
		18	1.0	0.0		
					coarse	
		25	0.5	1.0		
					medium	
		40	0.42	1.25		
	fine					
		60	0.25	2.0		
					fine	
		120	0.125	3.0		
					very fine	
		200	0.074	3.75		
SILT						
		230	0.062	4.0		
					SILT	
			0.0039	8.0		
CLAY					CLAY	
			0.0024	12.0		
					COLLOID	

Wentworth Scale for Gain-size Classification

		U.S. standard sieve mesh	millimetres		phi (φ) units	Wentworth size class
Gravel			4,096		−12	boulder
			1,024		−10	
			256	256	−8	
			64	64	−6	cobble
		5	4	4	−2	pebble
		6	3.36		−1.75	
		7	2.83		−1.5	granule
		8	2.38		−1.25	
		10	2.00	2	−1.0	
Sand		12	1.68		−0.75	
		14	1.41		− 0.5	very coarse sand
		16	1.19		−0.25	
		18	1.00	1	0	
		20	0.84		0.25	
		25	0.71		0.5	coarse sand
		30	0.59		0.75	
		35	0.50	1/2	1.0	
		40	0.42		1.25	
		45	0.35		1.5	medium sand
		50	0.30		1.75	
		60	0.25	1/4	2.0	
		70	0.210		2.25	
		80	0.177		2.5	fine sand
		100	0.149		2.75	
		120	0.125	1/8	3.0	
		140	0.105		3.25	
		170	0.088		3.5	very fine sand
		200	0.074		3.75	
		230	0.0625	1/16	4.0	
Mud	Silt	270	0.053		4.25	
		325	0.044		4.5	coarse silt
			0.037		4.75	
			0.031	1/32	5.0	
			0.0156	1/64	6.0	medium silt
			0.0078	1/128	7.0	fine silt
			0.0039	1/256	8.0	very fine silt
	Clay		0.0020		9.0	
			0.00098		10.0	
			0.00049		11.0	clay
			0.00024		12.0	
			0.00012		13.0	
			0.00006		14.0	

Grain-size Scales and Characteristics



-- from U.S. Geological Survey

ATTACHMENT B

B-1 Descriptors for Modified Burmister Soil Classification System

B-2 Plasticity of Soil Samples

Descriptors for Modified Burmister Soil Classification System

Grain-size Percentage Descriptors for Modified Burmister Soil Classification System

Fractions		**Proportion Descriptors**		
(+)	Major Fraction	**Quantity**	**Descriptor**	**Abbreviation**
(-)	Minor Fraction	35%-50%	and	a.
e.g., a medium- to- coarse SAND which is predominantly medium-grained would be written as: m(+)-c <u>SAND</u>		20%-35%	some	s.
		10%-20%	little	l.
		1%-10%	trace	t.
		Modifiers: (+)Upper end of the range (-) Lower end of the range		

Density and Cohesiveness of Soil Samples

Density of Cohesionless Soils		**Consistency of Cohesive Soils**	
Blow Counts	**Relative Density**[1]	**Blow Counts**	**Consistency**[1]
0 to 4	Very Loose (v.l.)	0 to 2	Very Soft (v.s.)
5 to 9	Loose (l.)	2 to 4	Soft (sf.)
10 to 29	Medium Dense (m.d.)	4 to 8	Medium (m.)
30 to 49	Dense (d.)	8 to 15	Stiff (stf.)
50 to 79	Very Dense (v.d.)	15 to 30	Very Stiff (vst.)
80 or more	Extremely Dense (e.d.)	30 or more	Hard (h.)

[1] Abbreviations indicated in parentheses

Plasticity of Soil Samples

Material	Symbol	Feel	Ease of Rolling Thread	Minimum Thread Diameter (inches)	Plasticity Index	Plasticity[1]
Clayey SILT	CyM	Rough	Difficult	1/4	1 to 5	Slight (Sl)
SILT&CLAY	M&C	Rough	Less Difficult	1/8	5 to 10	Low (L)
CLAY &SILT	C&M	Smooth, dull	Readily	1/16	10 to 20	Medium(M)
Silty CLAY	MyC	"Shiny"	Easy	1/32	20 to 40	High (H)
CLAY	c	Waxy, very shiny	Easy	1/64	40+	Very High (VH)

[1] Abbreviations indicated in parentheses

ATTACHMENT C

Description of Soil Properties

Description of Soil Properties	
Color	The color of the sample should be described for wet soil. If possible, the color should be referenced to a standard color chart, such as a Munsell Color Chart.
Primary Grain Size	Primary grain size refers to the size of the predominant sedimentary size class within the material (as judged visually). The grain size divisions should conform to the standard Wentworth Scale divisions, as shown on the "Wentworth Size Classification" table.
Secondary Grain Size(s)	Secondary grain size(s) refers to material which, as a grain-size group, comprises less than the majority of the soil sample. Aside from stating the size classification, the relative percentage of the material must be stated. The grain-size divisions should conform to the standard Wentworth Scale divisions as shown on the Wentworth Size Classification table. To describe the approximate percentage of the secondary grain size(s) present, qualifiers shown in the table entitled, "Descriptors for Modified Burmister Soil Classification System".
Moisture Content	The moisture content of the sample should be described as dry, slightly moist, moist, or wet. Gradation from one state to another should be recorded as, for example, moist to wet.
Sorting	The relative degree of sorting of the sediment should be indicated as poor, moderate, good, or very good. The degree of sorting is a function of the number of grain-size classes present in the sample. The greater the number of classes present, the poorer the sorting. In addition, for samples composed only of sand, the relative degree of sorting is a function of the number of sand-size subclasses present.
Sphericity	Sphericity is a measure of how well the individual grains, on average, approximate a sphere. The average sphericity of the sand and larger size fractions should be described as low, moderate, or high. A chart illustrating varying degrees of sphericity is attached.
Angularity	Angularity, or roundness, refers to the sharpness of the edges and comers of a grain (or the majority of the grains). Five degrees of angularity are shown in the attached chart illustrating varying degrees of roundness: *Angular* (sharp edges and comers, little evidence of wear); *Subangular* (edges and comers rounded, faces untouched by wear); *Subrounded* (edges and comers rounded to smooth curves, original faces show some areas of wear); *Rounded* (edges and comers rounded to broad curves, original faces worn away); and, *Well-rounded* (no original edges, faces, or curves, no flat surfaces remain on grains).
Sedimentary Structures	Sedimentary structures are such things as varved layers, distinct bedding, or stratification.
Density or Cohesiveness	The density or cohesion of a sample (for the purposes of this application) refer to the sample's resistance to penetration by a sampling device. Density is used in reference to sediments primarily silt-size and coarser while cohesiveness is used in reference to primarily clay-sized sediments. Density or cohesiveness can be assessed from the number of blows from "standard" split-spoon sampling (i.e., 140# hammer, 30" fall, 2" X 2" (O.D., 1 3/8" I.D.)) split-spoon samplers according to the scale in the table entitled "Density and Cohesiveness of Soil Samples".

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Soil Sampling

SOP #104

Revision Date: August 8, 2019

LIST OF REVISIONS

Date	Summary of Changes	Approval
	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

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August 8, 2019
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Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

This Standard Operating Procedure (SOP) provides the general procedures for Soil Sampling for environmental investigation- and remediation-related activities. The SOP was developed based on a number of sources that represent prevailing standards and guidelines typically used in the field of environmental investigation and remediation. However, the procedures described herein are not intended to supersede any applicable local, State or Federal regulations. Nor can the procedures described in this SOP take into account every condition that might be encountered in the field or every project-specific data quality objective. An important component of this SOP is the need to document those instances where the procedures described herein are not followed for a specific project, the rationale for not following the procedures described in the SOP, and a description of the alternative procedures that were used instead.

1.0 Introduction

Sampling of unconsolidated materials at a site may require the collection of those materials from the surface and/or subsurface. Although the term "soil" can have a specific definition based on the depth of unconsolidated materials to which the reference is being made, for the purposes of this Standard Operating Procedure (SOP), the term "soil" will be used regardless of the depth from which the samples are collected. Soil samples may be collected from the vadose zone (i.e., above the water table) or from the saturated zone (i.e., below the water table). Evaluation of such saturated soil samples should take into consideration the possibility that the detected contamination may be present due to groundwater transport versus a direct contaminant release at a given location.

The soil sampling procedure must also consider the potential for loss of volatile organic compounds (VOCs) during sample retrieval and handling and be designed accordingly. Procedures for sampling soils for subsequent laboratory analysis for VOCs are provided in the HRP SOP # 105, *Collection of Soil Samples for Analysis for Volatile Organic Compounds*.

Depending on project-specific data quality objectives and/or the project-specific work plan, field screening for various constituents may be indicated as a part of a soil sample collection effort. Because field screening for total volatile organic compounds (VOCs) using a photoionization detector (PID) is the most commonly performed field screening activity, procedures for such screening are described in **Attachment A** of this *Soil Sampling* SOP. In addition to field screening for total VOCs, screening of soil samples for the presence of non-aqueous-phase liquid (NAPL) or for metals may be important components of soil sampling at a site depending on the project-specific data quality objectives and the project-specific work plan. Procedures for such field screening will be provided in the individual project-specific work plan, since specifics of such screening procedures are more likely to be developed to meet the project-specific data quality.

Visual observation and characterization of soil samples is an important component of the soil sampling process. Procedures for geologic logging and characterization of soil samples are provided in HRP SOP # 103 entitled, *Soil Logging and Description Using a Modified Burmister Classification System.* When regulatory requirements or guidelines, or project-specific objectives require that the Unified Soil Classification System or other accepted soil classification system be used for a project, that classification system may be used in lieu of the Modified Burmister Classification System when such rationale is provided.

2.0 Specific Equipment List (not all items are required for a given sampling event)

- Personal protection equipment
- Stainless steel, Teflon, or polypropylene spatulas or scoops
- Stainless steel hand augers

- Stainless steel split spoons for soil sampling using a hollow-stem auger drilling rig

- Disposable acetate, lexan, or clear polyvinyl chloride (PVC) liners for direct-push soil sampling
- Stainless steel/glass pan
- Distilled water
- Plastic (polyethylene) sheeting
- Sample containers with labels
- Sample preservation materials and equipment
- Decontamination solutions/equipment
- Photoionization detector (PID) (preferred for most applications) and/or Flame Ionization Detector (FID)
- Coolers with ice (preferred) or ice packs

3.0 Documentation

- Site Plan/Activity Sheet
- Notebook/sketch pad
- Chain-of-custody record
- Instrument calibration logs (if required)
- Boring or test pit logs (as applicable)
- Applicable Soil Screening form(s)

4.0 Soil Sampling Precautions

1. Prior to conducting sampling, ensure that all necessary sampling equipment is clean and decontaminated in accordance with the site-specific work plan and/or decontamination procedures specified in Section 3.0 of HRP SOP # 101, *Advancement of Soil Borings in Unconsolidated Materials*.

2. Soil sampling for volatile or semivolatile analysis should be conducted using only stainless steel equipment or other chemically inert material that will not have the potential to contaminate the soil samples.

3. Soil samples collected for VOC analyses should never be mixed or composited. Sample collection for VOC analysis should be performed immediately after opening the sample collection device for each interval, before description of the soil sample or core and collection of samples for other analytes, to limit loss of VOCs from the sample due to volatilization. Soil sample collection techniques for VOCs are described in HRP SOP # 105, *Collection of Soil Samples for Analysis for Volatile Organic Compounds*. Procedures identified in that SOP are designed to ensure that soil samples are preserved in accordance with U.S. EPA Method 5035.

4. Generally, compositing of samples for any analysis should be performed only after careful consideration of sampling goals. In general, compositing is an acceptable and often required methodology only for waste characterization sampling.

5. Collection of samples for laboratory analysis at a single specified location should proceed in the order of greatest to least volatilization potential. As indicated above, sample

collection for VOC analysis must be conducted first, followed by collection of samples into sample containers in order of volatility (e.g. petroleum hydrocarbons, semivolatile organic compounds (SVOCs), PCBs, metals, etc.).

6. The QAPP, site-specific work plan, and/or work instructions should describe the management of excess soil (i.e., soil not placed into containers for laboratory analysis) generated during soil sampling activities. In the absence of a specific soil management policy, excess soil collected during sampling should be handled in accordance with HRP's policy for management of investigation-derived waste. In all cases, disposal of excess soil must be in accordance with applicable federal, state, and local regulations. Depending on federal, state, and local regulations and the project-specific QAPP, work plan, and/or work instructions, soil exhibiting evidence of contamination may be returned to the borehole if the project-specific goal is to remediate the soil in the area where the contaminated soil will be returned.

7. Decontamination of field sampling equipment should be performed in accordance with Section 3.0 of HRP SOP 101, *Advancement of Soil Borings in Unconsolidated Materials.* Any sampling equipment that is reused during the sampling activities must be decontaminated between collection of every sample.

In addition to decontamination between samples, all equipment used for sampling shall be cleaned and decontaminated and/or appropriately disposed of upon completion of all sampling requirements and prior to leaving the site. If more thorough decontamination is necessary than can be adequately performed in the field, such equipment should be wrapped in plastic and returned to the office for more complete decontamination.

Ideally, the project-specific QAPP, work plan, and/or work instructions should specify how decontamination fluids will be managed at the site. Any fluids generated during decontamination must be containerized for subsequent disposal in accordance with federal, state, and local regulations, and as specified in the site-specific QAPP, work plan, and/or work instructions. All decontamination fluids generated at the site shall be subsequently disposed of in accordance with federal, state, and local regulations, as well as procedures specified in the site-specific QAPP, work plan, and/or work instructions.

5.0 Soil Sample Collection from Split Spoons, Direct-push Samplers, and Similar Devices

1. Personal protective equipment (PPE) should be donned and maintained in accordance with the site-specific work plan and/or health and safety plan during all sampling procedures. In the event that no PPE has been specified for a particular sampling event, disposable nitrile gloves should be donned, at a minimum, during all sampling procedures. Gloves must be changed after sampling from each individual sampling interval.

2. Soil sample retrieval from the subsurface shall be performed using an appropriate sample retrieval device (i.e., split spoon, Macro-core®, etc.) based on project-specific objectives and as designated in the project-specific QAPP, work plan, and/or work instructions. After collecting soil from each designated sampling interval using the soil retrieval device, the device shall be placed on polyethylene sheeting. Under no circumstances should the sampling device be allowed to touch the ground surface or other sampling surface until after the soil sample(s) have been collected from the device. Sample collection using hand

augering techniques require special consideration, as indicated below in Section 6.0 of this SOP.

3. Collect soil samples for VOC analysis from the designated sampling interval(s) or sub-interval(s) as indicated in the site-specific QAPP, work plan, or work instructions as soon as possible after opening the soil sample retrieval device and prior to conducting other sampling activities. Methodologies for soil sample collection and preservation for VOC analysis is described in HRP SOP # 105, *Collection of Soil Samples for Analysis for Volatile Organic Compounds.* Collection of soil samples for VOC analysis from hand-augered sampling intervals requires special consideration, as indicated below in Section 6.0 of this SOP.

4. Following collection of soil samples for VOCs analysis, examine the soil core or soil sample to record color, texture, consistency, moisture content, and other pertinent characteristics in the field notebook or HRP boring log/field data sheet, as described in HRP SOP # 103, *Soil Logging and Description Using a Modified Burmister Classification System.*

5. Collect aliquots of soil from designated sampling intervals into appropriate sampling containers using a stainless steel or Teflon® sampling implement, such as a sampling spatula or spoon. In no instance should samples be placed into the sampling container using a sampling implement that is not made of inert material or a sampling glove.

   To ensure that the laboratory has sufficient sample volume to complete all analyses requested, fill sampling jars as completely as possible. Once filled, wipe rim and threads of sampling jar with a paper towel dampened with distilled water to remove excess soil particles that could interfere with proper closure of the jar lid.

6. If required, and if a sufficient sample is available after filling all jars, vials, etc., then soil from a given sample can be collected in a re-sealable plastic bag, or similar container, and screened in the field with a (PID) for total VOCs in accordance with the procedures described in **Attachment A**. Aliquots of soil may also be collected for screening purposes at this time.

7. Label the sample container(s) in accordance with procedures described in project-specific QAPP, work plan, and/or work instructions. Alternatively, sampling jars may be pre-labeled; in which case, the sample label should be double-checked prior to placing soil into the container.

8. Although compositing of samples is not generally appropriate, there may be circumstances when compositing of soil aliquots from two or more sampling intervals may meet project-specific Data Quality Objectives. **Under no circumstances may samples be composited for subsequent analysis for VOCs**.

   When samples are to be composited, the following approach should be used. Using decontaminated sampling equipment, collect and carefully place soil into a stainless steel bowl or pan to thoroughly mix or composite, if necessary. All soil samples must be thoroughly mixed to ensure that the sample is as representative as possible of the soil being sampled. One method used to effectively homogenize samples is described below:

   - the material in the sample pan should be divided into quarters

- each quarter should be mixed individually
- two quarters should then be mixed to form halves
- the two halves should be mixed to form a homogenous matrix
- procedure should be repeated several times until the sample is adequately mixed

Place aliquots of the homogenized sample into an appropriate, labeled container(s). If more than one sample container must be filled, place a spoonful of soil in each container in sequence and repeat until all containers are full or the sample volume has been exhausted.

Fill containers in the order of greatest volatilization potential to least potential for volatilization. As noted above in Section 3, sampling for VOC analysis should be performed first and should be conducted using the procedures described in HRP SOP #105, *Collection of Soil Samples for Analysis for Volatile Organic Compounds*.

9. Place sample(s) in cooler with ice (preferred to meet and maintain cooler temperature at 4ºC ± 2ºC) or ice packs as soon as possible following collection into sampling containers. Samples of waste or highly-contaminated media must not be placed in the same cooler as samples expected to contain low concentrations of contaminants.

10. Deliver, or arrange for delivery of, selected samples to the analytical laboratory or to be returned to the HRP office for subsequent delivery to the laboratory or to be maintained on hold pending the need to analyze the samples at a later date, unless such storage at the HRP office would not be in accordance with regional office sample storage and management procedures.

11. Follow field-specific sample handling procedures described in the project-specific QAPP, work plan, and/or work instructions.

12. Following sample collection and field-management of the collected sample(s), and before re-use, thoroughly decontaminate any reusable sampling collection devices (split-spoon sampler, direct-push samplers, hand auger, stainless steel spatula or spoon) after each sampling interval using appropriate decontamination procedures, as described in Section 3.0 of HRP SOP # 101, *Advancement of Soil Borings in Unconsolidated Materials*.

6.0 Soil Sample Collection from Hand Augers

1. Follow all procedures for soil sample collection described in Section 5.0 of this SOP, with the exceptions noted below.

2. Use a stainless steel hand auger to sample 0" to 6" or 0” to 12”, or other sampling intervals, as specified in the project-specific work plan. Generally, the hand auger can only collect a sample from intervals that are no more than approximately 6 inches at one time.

3. With the exception of sample collection for VOC analysis (which is described below) and when the objective for a sample collection interval is greater than the depth that can be achieved during a single retrieval of a hand auger from the subsurface, place each aliquot of soil retrieved by the hand auger from the specified sampling interval into a stainless

steel bowl or pan to be composited with additional soil from that sampling interval. Once soil retrieval from the full sampling interval is complete, homogenize the soil in the bowl using an appropriate technique (such as that described in Section 7), then collect soil samples into individual sampling containers to ensure that samples submitted for laboratory analysis are representative of the specified sampling interval.

4. When soil samples are to be collected from a hand auger for subsequent laboratory analysis for VOCs, the aliquot of soil collected for VOCs must be collected directly from the material inside the hand auger if at all possible. As a result, the site-specific work plan and/or work instructions should specify the specific 6-inch depth interval(s) from which the sample(s) for VOC analysis should be collected. If it not possible to collect the aliquot of soil for VOC analysis directly from the hand auger, the material in the hand auger may be placed into a large, zippered, polyethylene bag, which is tightly closed before the sample can be collected. The sample should then be collected from the polyethylene bag within no more than 5 minutes of removal from the subsurface.

7.0 Compositing of Soil Samples

Although compositing of samples is not generally appropriate, there may be circumstances when compositing of soil aliquots from two or more sampling intervals or locations may meet project-specific Data Quality Objectives. **Under no circumstances may samples be composited for subsequent analysis for VOCs**. When samples are to be composited, the following approach should be used.

- Following collection from the subsurface, place soil samples intended for compositing into a stainless steel bowl or pan to thoroughly mix or composite. Thorough mixing of the samples is important to ensure that the sample is as representative as possible of soil from the locations being sampled. One method used to effectively homogenize samples is described below:

    - the material in the sample pan should be divided into quarters
    - each quarter should be mixed individually
    - two quarters should then be mixed to form halves
    - the two halves should be mixed to form a homogenous matrix
    - procedure should be repeated several times until the sample is adequately mixed

- Place aliquots of the homogenized sample into an appropriate, labeled container(s). If more than one sample container must be filled, place a spoonful of soil in each container in sequence and repeat until all containers are full or the sample volume has been exhausted.

- Fill containers in the order of greatest volatilization potential to least potential for volatilization. As noted above in Section 3, sampling for VOC analysis should be performed first and should be conducted using the procedures described in HRP's SOP for *Collection of Soil Samples for Analysis for Volatile Organic Compounds*.

8.0 References for Soil Sampling Procedures

ASTM International. 2016. Standard Practice for Soil Investigation and Sampling by Auger Borings. ASTM D1452/D1452M-16.

New York State Department of Environmental Conservation (NYSDEC). 2010. "DER-10, Technical Guidance for Site Investigation and Remediation", Division of Environmental Remediation. May 2010.

U.S. Environmental Protection Agency (U.S. EPA) (2014). Soil Sampling, SESD Operating Procedure, SESDPROC-300-R3 (rev. 3), U.S. EPA Science and Ecosystem Support Division, August 21, 2014.

ATTACHMENT A

Attachment A

Field Screening of Soil Using a Photoionization Detector

Photoionization detectors (PIDs) are used in general screening of soil, water, or air for the presence of volatile organic compounds (VOCs). The instrument is used only to screen for the presence of total concentrations of VOCs, not for the presence of individual constituents, and not all constituents of interest may be detected by the instrument. It is also possible to screen soil samples for the presence of VOCs using a flame ionization detector (FID), but use of this instrument is far less frequent than a PID. Procedures for field screening of soil samples using an FID are provided in HRP SOP # 2-005, *Field Screening Procedures for Soil Samples.*

Because PIDs can only ionize molecules in air, no liquids or solids should be introduced into the sample line. A PID can have limited use in higher humidity or in the presence of methane due to potential fouling of the lamp, although performance may be improved by using a vapor trap in those PID models that may be equipped with one.

Users should refer to the operation manual for the instrument being used to ensure that the electron voltage for the bulb used is appropriate for compounds of interest. For example, use of higher electron volt (ev) bulbs (generally 11.7 ev) are needed for halogenated alkanes, such as 1,1,1-trichloroethane, or higher molecular weight aromatic compounds due to the increased strength of the bonding force of these chemicals. For general screening purposes, use of a 10.6 ev bulb as an "all purpose" bulb is recommended. However, predetermination of compounds of interest is helpful before deciding which bulb to use for a specific project.

Generally, short-chain, alkane hydrocarbons, such as octane or those compounds generally found in mineral spirits, do not exhibit a high response factor to a PID, and therefore, the presence of those compounds may not be detected by the instrument. In such cases, an FID may be appropriate to use in conjunction with the PID if such compounds are of specific concern.

<u>Specific Equipment List</u>

- PID (Photovac^{tm} Microtip, Photovac^{tm} 2020, MIniRae^{tm} 3000, or equivalent)
- Re-sealable plastic/polyethylene bags
- Personal protection equipment
- Calibration gas

<u>Documentation</u>

- Site plan
- Activity log/Sample log
- Notebook/Sketch pad
- PID calibration Guide

Procedure – For Soil/Solid Matrix Samples

Following calibration of instrument per manufacturer's procedures:

1. Record background reading.
2. Place a small quantity of soil to be tested (between 50 to 150 grams) into a re-sealable plastic/polyethylene bag.
3. Let soil warm to ambient temperature. Care should be taken to ensure that the equilibration temperature is relatively consistent throughout the day (e.g. 50 degrees in the morning compared to 75 degrees in the afternoon). (When the ambient temperature is below approximately 50º F, it is recommended that soil samples be brought into a warmer environment and allowed to equilibrate to the warmer ambient temperature before proceeding with measurement of the sample.)
4. Insert probe tip into bag (do not allow the probe tip to touch the matrix) by puncturing the side of the bag in such a manner so as to avoid the potential loss of volatiles to the atmosphere before the probe tip can be inserted.
5. Record reading.

Samples that are wet may give a false positive reading. This effect may be present if readings gradually increase with no discernable leveling off. If this effect is observed, the instrument bulb should be cleaned, and the instrument should be recalibrated prior to re-testing the sample. If the response persists, the screening results should be noted as suspect. However, to help minimize the effect of moisture on screening results, some PID models may be equipped with a moisture trap to remove at least some of the moisture as the air enters the instrument.

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Collection of Soil Samples
for Analysis for Volatile Organic Compounds

SOP #105

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LIST OF REVISIONS

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	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

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Gail L. Batchelder

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August 8, 2019
Date

Vice President/
Practice Leader – Environmental

Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

105 Soil Sample Collection for VOC Analysis SOP

Preamble

This Standard Operating Procedure (SOP) provides the general procedures for collecting and preserving soil samples for analysis for volatile organic compounds in accordance with EPA Method 5035 during environmental investigation- and remediation-related activities. The SOP was developed based on sources that represent prevailing standards and guidelines typically used in the field of environmental investigation and remediation. However, the procedures described herein are not intended to supersede any applicable local, State or Federal regulations. Nor can the procedures described in this SOP take into account every condition that might be encountered in the field or every project-specific data quality objective. An important component of this SOP is the need to document those instances where the procedures described herein are not followed for a specific project, the rationale for not following the procedures described in the SOP, and a description of the alternative procedures that were used instead. In such situations, state-specific protocols should be explicitly cited as part of the document of procedures.

(Note: The text of this Standard Operating Procedure has been taken in large part from the guidance document published by the Connecticut Department of Energy and Environmental Protection entitled, *GUIDANCE FOR COLLECTING AND PRESERVING SOIL AND SEDIMENT SAMPLES FOR LABORATORY DETERMINATION OF VOLATILE ORGANIC COMPOUNDS,* Final, February 28, 2006, because that document provides a thorough discussion of sampling procedures that may be used to be consistent with U.S. EPA protocols, preservation methods, and other applicable guidance on the subject.)

1.0 INTRODUCTION

Soil and sediment samples collected for laboratory analysis for volatile organic compounds (VOCs) require special handling to prevent loss of VOCs leading to low-biased results. This Standard Operating Procedure (SOP) describes soil sample collection and preservation techniques designed to minimize losses from soil and sediment samples (hereinafter referred to as soil samples) due to volatilization and biodegradation during collection, storage and analysis. This procedure does not allow for the compositing of soil samples for VOC analysis because of the potential for loss of VOCs during the compositing process.

The procedure described herein refers only to the collection and preservation of sub-samples of soil in accordance with EPA Method 5035 for subsequent laboratory analysis for VOCs. HRP SOP #2-002, *Soil Sampling*, describes more general procedures associated with soil sample collection for environmental purposes and laboratory analysis for other constituents.

2.0 SOIL SAMPLING TECHNIQUES FOR LABORATORY ANALYSIS FOR VOCS

2.1 Overview of Sampling Approach

The soil sample collection procedure for determination of VOCs is a two-step process:

> **Step 1 – Collect an undisturbed soil sample**, as defined below, from the subsurface, or expose the targeted area from where a sub-sample for laboratory analysis will be collected,
>
> **Step 2 – Collect a representative sub-sample** from the undisturbed sample or directly from the exposed subsurface.

2.2 Collection of Undisturbed Samples

Undisturbed samples are those for which the sampling device minimizes break-up of the structure of the soil to the extent practicable. Undisturbed samples can be collected using such techniques as:

- Coring, such as the methods utilizing split-spoon sampling devices, MacroCores®, and large-bore direct-push samplers;
- Bulk sampling, for example, undisturbed soil volumes collected using a backhoe bucket from sidewalls of trenches and excavations where direct access to the sampling location (sidewall or bottom) is not safe; and
- Direct collection of samples from the surface or subsurface using a device such as a hand auger.

When collecting samples for laboratory determination of VOCs, the device used to collect the undisturbed soil sample must be removed as soon as possible from the subsurface; and most importantly, **the sub-samples that are intended for VOC determination must be collected as soon as possible to reduce loss of VOCs due to volatilization (Ideally, sub-samples should be collected within five minutes of opening the soil sample collection device and prior to any disturbance of the soil core other than slicing open the soil core itself. Aliquots of soil for laboratory analysis must be collected from the interior of the core, without including any portion of the core that has been in contact with the sampling device).**

Attempts must be made to further minimize loss of VOCs by managing the sample collection environment (i.e., limiting sun, wind, heat, etc.).

Planning and careful preparation are critical for a successful sampling event. Checklists should be used to ensure that all necessary equipment and supplies are present and in proper working order and that the following conditions are achieved:

- Undisturbed soil to be collected for sub-sampling for VOCs should be collected in a manner that controls the acquisition of the samples such that they do not “stack up” awaiting logging and sub-sampling;
- Soil cores should not be stored in large-diameter sample collection equipment, orsmaller-diameter sampling devices or capped liners (brass, acetate, lexan, polycarbonate etc.) for longer than 10 to 15 minutes prior to collection of sub-samples

for VOC analysis. In all cases following collection of soil cores or samples from the sub-subsurface and prior to collection of the sub-samples for VOC analysis, soil retrieved from the sub-surface must be tightly capped or covered to minimize the potential for volatilizations of VOCs from the retrieved soil before the sub-samples for VOC analysis can be collected;

- Cores should not be exposed to extreme weather conditions, such as direct sunlight, rain and wind, and sub-sample collection should occur in an area that minimizes exposure to the elements (e.g., under cover, shady areas); and
- Undisturbed soil samples cannot be transferred from the core sampler to a secondary container (empty sample bottle, plastic bag, aluminum foil, or sampling bowls) for future sample collection.

To the extent practicable, undisturbed samples should always be collected. However, in some cases, collection of a disturbed sample may be necessary to characterize source areas or other critical locations. If disturbed soil samples must be collected, the rationale for collecting such disturbed samples must be provided. However, under no circumstances should a sub-sample be collected from a disturbed sample that was previously used for field-screening purposes.

2.3 Collection of the Soil Sub-Samples for Analysis for VOCs

Sub-samples are those samples that are submitted to the laboratory for analysis for VOCs. Sub-sampling of the undisturbed soil sample must be performed using a dedicated or decontaminated, small-diameter sampler. Sub-samples must be collected as soon as possible from the undisturbed sample after the undisturbed soil sample is collected.

3.0 OVERVIEW OF SUB-SAMPLING DEVICES

Sub-sampling of the large-diameter or bulk sampling device for VOCs must be performed with the use of a dedicated or decontaminated small-diameter core sampler. The small-diameter core sampler must be capable of collecting the required amount of sample from the large-diameter sampling device (e.g., split-spoon or soil corer) or from freshly exposed subsurface soils. The small-diameter core sampler must be capable of delivering the sample quickly and directly into the sample container without disturbing the native soil structure.

Small-diameter core samplers used in the collection of samples for VOCs must be constructed of non-reactive materials that will not sorb, leach or alter the concentration of VOCs in the sample. Examples of these materials are stainless steel, glass and brass. Other materials, such as Viton®, PTFE and some rigid plastics, which have demonstrated limited absorptive or diffusive passage of VOCs, can be used as long as the contact time between the sample and the sampler is minimized, or the materials are used for an airtight seal of the sampler. It is important to note that some syringes may be coated with glycerin and should not be used.

There are many acceptable small-diameter core samplers. Product names are included in this SOP for illustrative purposes and do not indicate that a specific sampling device be used as long as the data quality objective for sample collection can be met by a specific device and the suitability of the selected small-diameter core sampler not otherwise indicated in this SOP is explained.. Currently available small-diameter core samplers include a modified 10-milliliter (ml) disposable plastic syringe, a Purge and Trap Soil Sampler®, En Core® samplers, Easy Draw Syringe® or other small-diameter tube/plunger sampler.

The small-diameter core sampler should fit inside the mouth of the sample container to avoid loss of sample, prevent damage to the sealing surfaces or container threads and ease the soil transfer process.

3.1 Procedure for Obtaining Test Samples to Determine Sub-Sample Volume

The procedures used by the analytical laboratories to determine VOC concentrations in soil require approximately equal amounts of soil and liquid to be used in the procedure. If the ratio of soil to liquid is too high, the soil will not be adequately dispersed in the liquid, leading to poor results. If the amount of soil is too low, the detection limits will be raised, which could potentially affect the usability of the results.

The small-diameter core sampler must be able to deliver a minimum of 5 grams of sample (≈ 3 cm^3 of sample, assuming a density of 1.7 g/cm^3) into a 40-ml VOA vial. While most small-diameter core samplers can only be used for sampling and placement into the appropriate sample containers, only the En Core®-type samplers can be used for sampling, storage, and transportation of the sample to the laboratory. Small-diameter core samplers should be selected based upon the properties of the matrix, the type of preservation method (field vs. lab), and personal preferences.

It is important that the small-diameter core sampler provide the required mass of sample material. Consequently, it is often valuable to perform a test of sample collection procedures using the small-diameter core sampler by collecting a test sample (of similar matrix to that being sampled) and weighing that sample to determine the amount of soil needed to obtain the required mass of sample material for each type of small-diameter core sampler and analytical method.

The procedure for obtaining a test sample is as follows:

1. Using a small electronic portable scale with an accuracy of 0.1 grams, weigh the empty small-diameter core sampler (e.g., disposable syringe) to the nearest 0.1 grams. The scale must be calibrated before use and intermittently checked during the day to ensure accurate weight measurement. Calibration information must be recorded in the field logbook. A translucent cover can be placed over the scale during the weighing process to negate variations caused by wind.

2. Push the small-diameter core sampler test sample into the matrix to collect the required mass of material (3 cm^3 should yield approximately 5 grams of sample [wet weight]).

3. Wipe clean any soil adhering to the outside of the small-diameter core sampler before weighing.

4. If the weight is above the required amount, remove excessive soil by extruding a small portion of the core and cutting it away with a decontaminated trowel or spatula. If the weight is below the weight limit, obtain additional soil by reinserting the small-diameter core sampler into the soil core. Re-weigh after each addition or removal of sample from the small-diameter core sampler until the target weight is attained. Note the sample volume and amount in the small-diameter core sampler.

5. Discard the test sample appropriately.

6. Use the volume of the test sample as a guide in collecting the appropriately sized sub-sample of a similar matrix. Additional test samples should be weighed whenever a change in the matrix is observed.

3.2 Overview of Procedure for Collection of Sub-Samples

The goal of soil sampling for the purposes of evaluating concentrations of VOCs in soil is to obtain a representative soil sample in accordance with the data quality objectives for the project. Often, this is accomplished using an appropriate small-diameter core sampler.

Different sample matrices (e.g., sand, gravel, clay, fill) may warrant slightly different sub-sampling field techniques. The goal for all techniques is to collect the sub-sample as quickly as possible while minimizing disruption. For sub-samples that do not fit into the samplers, the rationale for any deviations from this guidance must be documented.

The procedure for obtaining soil sub-samples is noted below. It is important to remember that collection of sub-samples from a soil core or other sampling device **must** be performed first, as soon as the device is opened, in order to minimize losses of VOCs from the soil. Geologic logging of the soil core, collection of an aliquot of soil for field screening, and collection of soil samples for submittal to the laboratory for other analysis must be performed after collection of the sub-sample(s) for VOC analysis from that soil core or sampling device has been performed.

Sub-sampling procedures for collection of soil for VOC analysis are as follows:

1. Once the sampling interval has been selected, expose a fresh surface of the soil for collection of a sub-sample for VOC analysis. A loss of VOCs from the surface of the soil will occur even if the soil has been exposed for a short period of time (during screening, etc.). Removal of the unwanted surficial material can be accomplished by scraping the soil surface with a decontaminated spatula or trowel. Soil sampling must commence immediately once a fresh surface has been exposed.

2. Using the test sample as a guide, push the small-diameter core sampler into the matrix to collect a volume of material that will yield the required mass of sample (wet weight) as determined by the analytical method.

3. Depending upon the texture, depth or moisture content, insert the small-diameter core sampler straight into the matrix, on an angle. Multiple insertions can be made to obtain the required sample weight or to provide a more representative sub-sample from the desired sampling interval.

4. After sample collection, wipe the outside of the small-diameter core sampler to remove any excess material adhering to the barrel using a paper towel dampened with distilled water.

5. Immediately open the sample container and extrude the soil core into the sample container that will be submitted to the laboratory. Avoid splashing any preservative, if present, out of the sample container by holding the container at an angle while slowly extruding the soil core into the sample container. Do not immerse the small-diameter core sampler into the preservative. If an En Core®-type sampler is to be used for storage and shipment, prepare the sampler for shipment according to manufacturer's instructions.

6. Collect the required number of sample containers or En Core®-type samplers based on the chosen preservation and analytical methods, as discussed in the subsequent section on soil preservation methods.

7. Collect an additional aliquot of soil from the sampling interval into a separate sample container for determination of soil moisture content. A two-ounce jar is usually sufficient for this purpose or it should be indicated on the chain-of-custody that an aliquot may be extracted for this purpose from the sampling jar submitted for laboratory analysis. Collect an additional 50- to 150- gram aliquot of soil from the sampling interval to be used for field screening for total VOCs using a PID and/or FID in accordance with procedures described in Attachment A of HRP SOP # 2-002, S*oil Sampling*.

8. As noted above, ensure the threads and cap of the sample container or En Core®-type sampler are free of soil particles by wiping with a clean paper towel, dampened with distilled water to remove soil particles from the threads and sealing surface of the sample container or En Core®-type sampler.

9. Record the laboratory and field identification numbers in the field notes and on the chain of custody. Record the sample identification information on the sample container using a suitable marker. Container labels with wire or rubber band attachments can be used, provided they can be removed easily for sample weighing. Do not attach any additional adhesive-backed labels or tape to the sample containers unless requested by laboratory or specified in manufacturer instructions. This will increase the weight of the sample container and the laboratory will not be able to determine the sample weight.

10. After sample collection, immediately return the containers to an iced cooler. Sample containers from different locations should be placed in separate ziplock bags to help avoid cross-contamination. The laboratory sample number or field sample identification number may be placed on the bag and cross-referenced on the chain of custody. Proper sample management and chain-of-custody procedures should be maintained at all times from sample collection to transfer of samples to the laboratory. The laboratory performing the analysis will determine the sample weight.

4.0 PRESERVATION OF SOIL SAMPLES

4.1 Overview of the Soil Preservation Procedure

The preservation of samples for VOC analysis can be initiated either at the time of sample collection or in the laboratory. This section deals with the preservation of soil samples in the field using chemical and physical preservation methods.

It is important that the laboratory analytical methods, field preservation methods, appropriate sample containers and sample holding times are determined prior to mobilizing to the field. It is also necessary to consider that additional sample containers maybe required for various quality assurance/ quality control (QA/QC) samples such as matrix-spike and matrix-spike duplicates (MS/MSD). The number of extra containers required varies by laboratory and analytical procedure.

In addition to the various chemical preservation methods, samples must be physically preserved (e.g., iced or frozen) in the field immediately upon sample collection. It is important to match up the correct physical preservation method with the appropriate sample container and field chemical preservation method. According to U.S. EPA Contract Laboratory Protocol (CLP) Guidance for Field Samplers, the physical preservation methods are described as:

Iced – soil and sample containers are cooled to 4º ± 2ºC.

Frozen – soil and sample containers are cooled to between -7º to -15º C.

Sample containers that will be frozen should be placed on their side prior to freezing process to prevent breakage. Additional aliquots for screening and moisture determination need only be iced and kept cooled at 4º ± 2ºC; these sample containers should not be frozen. **Sample containers and En Core®-type samplers should not be frozen below -20º C, as the integrity of the container seals, o-rings and septum may be compromised by the freezing, resulting in the loss of VOCs upon thawing of the sample.**

En Core®-type samplers with soil containing greater than approximately 20% moisture should not be frozen. Greater than 20% moisture is extremely moist and is easy to spot with visible pooling of liquid on the sample surface. In most cases involving soil sampling, greater than 20% moisture is unusual.

In addition, the use of dry ice to freeze samples immediately upon sample collection or for use during shipment is not recommended. Dry ice, which is at a temperature of -78.5ºC, will lower the temperature of the sample container below the design specifications, causing damage to the glass, septum, seals, o-rings, and cap. In addition, dry ice has specific handling, storage and shipping requirements that outweigh its usefulness to the field sampling team.

4.2 Sub-Soil Sample Collection Procedures

When collecting soil sub-samples for determination of volatile organic compounds, up to four types of samples may be required:

- A high-concentration-level sample
- A low-concentration-level sample
- An SPLP/TCLP sample
- A sample for percent solids determination

Samples for both high-concentration level and low-concentration levels are necessary for each subsample, since the actual concentration in the soil retrieved from the subsurface is not known prior to analysis. Additional samples may be necessary for matrix spikes and matrix spike duplicates. Field and trip blanks also may be required.

An overview of the various options for sample collection procedures is attached as Figure 1.

4.3 High-Concentration Sub-sample Collection Procedures

There are two options for collection of the high-concentration sample: collection of the sample in a methanol preserved VOA vial or using En Core®-type samplers.

4.3.1 High-Concentration Sample Option 1, Methanol Preservation

Supplies:

Electronic field balance accurate to 0.1 grams

Minimum of one VOA vial (40 ml), pre-weighed and containing 5 or 10 mls of methanol

Sub-sampling device

1. Label the vials as appropriate. Do not add more weight (e.g., excessive labels) to the pre-weighed vials.

2. Weigh the vials to confirm the recorded vial weight.

3. Select the area to be sampled as soon as possible after the soil is exposed.

4. Obtain a test sample, using the coring device and field balance, to determine approximately how much volume of soil will yield equal grams of soil to methanol (5 or 10 ± 1 grams). This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.

5. Scrape away the surface material from the area to be sampled to expose fresh soil.

6. Rapidly insert the syringe into the soil to obtain the sample. Quickly extrude the sample into the vial containing the methanol. Wipe off the threads and cap; seal the vial.

7. Using the field balance, weigh and record the weight of the vial. A record of the weight must be submitted with the samples to the laboratory.

8. Place sample in cooler with ice.

9. Collect separate sample for percent solids, if necessary.

4.3.2 High-Concentration Sample 2, Use of En Core®-Type Samplers

Supplies:

One 5 or 10 -gram En Core®-type Sampler

1. Label the sample as appropriate.

2. Select the area to be sampled as soon as possible after the soil is exposed.

3. Scrape away the surface material from the area to be sampled to expose fresh soil.

4. Rapidly insert the sampler into the soil to obtain the sample. Quickly wipe the contact areas to remove any soil particles, close and seal the device.

5. Place devices in resealable pouch, place in cooler on ice.

6. Collect separate sample for percent solids, if necessary.

7. Samples must be frozen, preserved, or analyzed within 48 hours of collection.

4.4 Low-Concentration Sub-Sample Collection Procedures

There are four options for collecting low-concentration soil samples:

- collection in VOA vials containing water
- collection in empty VOA vials
- collection using En Core®-type devices
- collection in VOA vials containing sodium bisulfate.

All of the procedures using VOA vials are essentially the same, with the exception that there are specific limitations associated with preservation using sodium bisulfate, including formation of acetone in samples containing high amount of humic material, and certain analytes, such as styrene, vinyl chloride, trichloroethene (TCE), may be decomposed by the bisulfate, leading to low-biased results, and carbonate-rich soils may effervesce, which will result in significant losses of VOCs. Due to these limitations, use of sodium bisulfate as a preservative is discouraged unless there is a compelling reason why it is necessary for a specific project or because it is a regulatory requirement.

4.4.1 Low-Concentration Sample Option 1, Collection in VOA Vials Containing Water

Supplies:

Electronic field balance accurate to 0.1 grams

Two VOA vials (40 ml), pre-weighed and containing 5 mls of water and a magnetic stir bar

Sub-sampling device

1. Label the vials as appropriate. Do not add more weight (e.g., excessive labels) to the pre-weighed vials.
2. Select the area to be sampled as soon as possible after the soil is exposed.
3. Obtain a test sample, using the coring device and field balance, to determine approximately how much volume of soil will yield 5 grams of soil. Note that the sample weight should be within 1 gram of the nominal weight, e.g. 5± 1 gram. This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.
4. Scrape away the surface material from the area to be sampled to expose fresh soil.
5. Rapidly insert the syringe into the soil to obtain the first 5-gram sample. Quickly extrude the sample into one of the two vials containing the water. Wipe off the threads and cap; seal the vial.
6. Repeat steps 4 and 5 for the second vial containing water.
7. Using the field balance, weigh and record the weight of each vial. A record of the weight must be submitted with the samples to the laboratory. Often, the laboratories will supply pre-weighed vials, so weighing the vials in the field would not be necessary in such cases.
8. Place all samples in cooler with ice.
9. Collect separate sample for percent solids, if necessary.
10. Samples must be frozen or analyzed within 48 hours of collection.

4.4.2 Low-Concentration Sample Option 2, Collection in Empty VOA Vials

Supplies:

Electronic field balance accurate to 0.1 grams

Two VOA vials (40 ml), pre-weighed containing a magnetic stir bar

Sub-sampling device

1. Label the vials as appropriate. Do not add more weight (e.g., excessive labels) to the pre-weighed vials.
2. Select the area to be sampled as soon as possible after the soil is exposed.

3. Obtain a test sample using the coring device and field balance, to determine approximately how much volume of soil will yield 5 grams of soil. Note that the sample weight should be within 1 gram of the nominal weight, e.g. 5± 1 gram. This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.

4. Scrape away the surface material from the area to be sampled to expose fresh soil.

5. Rapidly insert the syringe into the soil to obtain the first 5-gram sample. Quickly extrude the sample into one of the two vials. Wipe off the threads and cap; seal the vial.

6. Repeat steps 4 and 5 for the second vial.

7. Using the field balance, weigh and record the weight of each vial. A record of the weight must be submitted with the samples to the laboratory. As noted above, this step is not necessary of the laboratory supplies pre-weighed vials.

8. Place all samples in cooler with ice.

9. Collect separate sample for percent solids, if necessary.

10. Samples must be frozen or analyzed within 48 hours of collection.

4.4.3 Low-Concentration Sample Option 3, Collection Using En Core®-Type Devices

Supplies:

Two 5-gram En Core®-type sampling devices

1. Label the sample as appropriate.

2. Select the area to be sampled as soon as possible after the soil is exposed.

3. Scrape away the surface material from the area to be sampled to expose fresh soil.

4. Rapidly insert the sampler into the soil to obtain the first sample. Quickly wipe the contact areas to remove any soil particles, close and seal the device. Place device in re-sealable pouch

5. Repeat steps 3 and 4 for the second En Core®-type device.

6. Place both devices in resealable pouches, place in cooler on ice.

7. Collect separate sample for percent solids, if necessary.

8. Samples must be frozen, preserved or analyzed within 48 hours of collection.

4.4.4 Low-Concentration Sample Option 4, Collection in VOA Vials Containing Sodium Bisulfate

Supplies:

Electronic field balance accurate to 0.1 grams

Two VOA vials (40 ml), pre-weighed containing 5 ml sodium bisulfate solution and a magnetic stir bar

Sub-sampling device

1. Label the vials as appropriate. Do not add more weight (e.g., excessive labels) to the pre-weighed vials.

2. Select the area to be sampled as soon as possible after the soil is exposed.

3. Obtain a test sample using the coring device and field balance to determine approximately how much volume of soil will yield 5 grams of soil. Note that the sample weight should be within 1 gram of the nominal weight, e.g. 5 ± 1 gram. This step may be skipped when the amount of soil needed for a particular matrix at a site has been determined.

4. Scrape away the surface material from the area to be sampled to expose fresh soil.

5. Rapidly insert the syringe into the soil to obtain the first 5-gram sample. Quickly extrude the sample into one of the two vials containing the bisulfate solution. Wipe off the threads and cap; seal the vial.

6. Repeat steps 4 and 5 for the second vial.

7. Using the field balance, weigh and record the weight of each vial. A record of the weight must be submitted with the samples to the laboratory.

8. Place all samples in cooler with ice.

9. Collect separate sample for percent solids, if necessary.

4.5 Collection of Soil Samples for TCLP or SPLP Extraction and VOC Analysis

The holding time for soil samples to begin the leaching procedure for Toxicity Characteristic Leaching Procedure (TCLP) or Synthetic Precipitation Leaching Procedure (SPLP) extraction for VOC analysis is 14 days from collection. Therefore, any samples collected for TCLP or SPLP extraction and placed on “hold” pending results of total analysis for VOCs for a given sampling interval, must be analyzed within the 14-day holding time.

Supplies:

25-gram En Core®-Type Sampler

1. Label the sampler as appropriate.

2. Select the area to be sampled as soon as possible after the soil is exposed.

3. Scrape away the surface material from the area to be sampled to expose fresh soil.

4. Rapidly insert the sampler into the soil to obtain the sample. Wipe off the threads and cap; seal the sampler.

5. Place sampler in re-sealable pouch and place in cooler with ice.

6. Samples must be frozen or leached within 48 hours of collection.

4.6 Collection of Soil Samples for Percent Solids Determination

A laboratory typically can use any container submitted for analysis to determine the percent solids of a soil, **except a container submitted for VOC analysis.** If the other laboratory analyses, besides volatile organic compounds (either total or TCLP/SPLP for VOCs), are to be performed on soil for a given sampling interval and location, a separate container(s) will be needed for the other tests. The percent solids determination can then be performed using the soil in the container(s) for the other tests. In the event that only VOCs are to be determined for a given soil sample, an additional sample (no more than 20 grams are needed) must be collected in a separate container and submitted to the laboratory.

5.0 REFERENCES

Connecticut Department of Energy and Environmental Protection (2006). *Guidance for Collecting and Preserving Soil and Sediment Samples for Laboratory Determination of Volatile Organic Compounds*, ver. 2, Final, February 28, 2006,

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HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Sample Handling

SOP #106

Revision Date: August 8, 2019

LIST OF REVISIONS

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	Original document preparation	
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August 8, 2019
Date

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Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

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ATTACHMENT

Attachment A Representative Chain-of-Custody Form

1.0 INTRODUCTION

This SOP identifies the containers, preservatives, sample preparation, chain-of-custody procedures, and QA/QC procedures associated with the various types of samples collected and analyzed by HRP.

Equipment:	This SOP deals primarily with methods requiring no equipment other than sample containers.
Documentation:	Field notebook and map or field work sheets to detail location of sampling points and relevant information related to sample collection. Chain-of-custody form for each sample delivery group.

2.0 CONTAINERS

2.1 Soils and Unconsolidated Materials

Samples of soil and other unconsolidated materials will be collected into wide-mouth glass jars with tightly fitting lids, or other appropriate container based on the analyses to be conducted. Specific information related to the appropriate container can be found in the project-specific Quality Assurance Project Plan (QAPP) and/or work plan. Sample containers to be submitted directly to the laboratory should be filled to the extent possible to eliminate any headspace and to ensure that sufficient sample is available for all analyses to be performed, although filling the jar completely is not required if that amount of soil is not needed to accomplish the project objectives for analyses to be performed.

However, for those samples for which analysis for volatile organic compounds (VOCs) will be conducted, EPA Method 5035A methods for sample collection and preservation will be used. Those methods are described in detail in HRP SOP #105 *Soil Sample Collection for VOC Analysis*. For such samples, 40-milliliter (ml) vials are obtained in advance from the laboratory filled with the appropriate amount of methanol and/or sodium bisulfate, and the vials are filled with the appropriate amount of soil specified by the SOP or the laboratory (if different).

2.2 Liquids

Several types of containers are available for liquid samples. The type(s) of container to be used are determined by the analyses to be performed and the nature and chemical properties of the liquid. Another factor that influences the type of container used for storage and transport of liquids is the sample volume requirements for the specific analyses to be performed. For example, oil samples may be contained in wide-mouth glass jars, similar to containers used for unconsolidated samples. Since samples collected for VOC analysis may undergo a loss of volatile constituents, vials used for water samples collected for subsequent VOC analysis must be fitted with Teflon™ septa and must be overfilled before closing to ensure that no headspace (air) is present in the vial. Other constituents may be subject to photochemical degradation and thus require collection into amber glass containers. Preservatives that must be used for liquid samples are specific to the nature and chemical properties of the specific analytes for which analysis is to be conducted. Information on sample collection requirements are provided in the QAPP and/or project-specific work plan.

2.3 Gasses

Gasses are intrinsically mobile and must be contained in fully-enclosed containers. The following types of container are available: Tedlar™ bags and glass bulbs with Teflon™ septa to allow insertion of hypodermic syringes. Summa® canisters are also typically used, especially for sub-slab soil vapor samples and indoor air samples that are used to evaluate vapor intrusion. Specifications for sample collection devices for gas samples should be selected based on data quality objectives for the project and will be specified in the project-specific QAPP and work plan.

3.0 PRESERVATION

Preservation requirements are provided in the QAPP and/or site-specific work plan that is developed for a project. Should there be any questions regarding preservation of samples, the analytical laboratory should be contacted or the most current update of EPA SW-846 should be consulted.

3.1 Refrigeration

Samples which do not require refrigeration are: oil samples; gaseous samples; and water samples to be analyzed only for metals. All other samples must be kept cool (ideally at 4°C ± 2°C) until delivery to the lab for analysis. Soil samples intended for VOC analysis should be preserved and otherwise managed in accordance with HRP SOP # 105.

Samples must not be allowed to freeze in cold weather. The jars/vials could break and the samples will be lost. Storage and transport containers and modes of transport must take the potential for freezing into account.

3.2 pH Adjustment and Other Preservatives

The pH of water samples should be adjusted in the field, as necessary, using the preservatives which are specified in the QAPP and/or site-specific work plan or the most recent SW-846 promulgated method for the requisite analytical parameter. Questions on preservatives should be directed to the analytical testing laboratory.

Gaseous samples do not require preservatives or pH-adjusting compounds to be added. In general, samples of unconsolidated material (soil, concrete, sediment) or sludge do not require the addition of a preservative. The exception is analysis for VOCs, in which case soil and sediment samples should be collected using EPA Method 5035A. These samples should be collected in vials pre-preserved with methanol and/or sodium bisulfate. The soil/preservative ratio should be indicated on the sampling container prior to sample collection or obtained directly from the testing laboratory. Additional detail on sample collection for subsequent VOC analysis is provided in HRP's SOP #105, as noted in Section 2.1.

3.3 Holding Times

Holding times for various parameters are specifically indicated in the most recent EPA SW-846 promulgated method for the requisite analytical parameter. Questions on holding times should be directed to the analytical laboratory. Additional information regarding sampling containers, preservation, and holding times will be made available in the QAPP and/or site-specific work plan.

4.0 SAMPLE COLLECTION AND PREPARATION

Samples will collected into appropriate, laboratory-supplied containers recommended for the media and analytical methods, as indicated in Section 2.0, and other relevant documents, such as the QAPP and site-specific work plan.

4.1 Filtration

Groundwater samples should not be filtered prior to analysis, except as allowed in accordance with regulatory guidance. The appropriateness of filtration for water samples and filter size is based on a number of factors, including objectives for the sampling effort, data quality objectives for the project, and regulatory considerations related to filtration of water samples. The need for filtration of groundwater samples must be discussed in the project-specific work plan, and the discussion must include the rationale for collection of filtered groundwater samples, as well as the procedures that would be used for collection of the filtered samples. Unless specifically indicated otherwise in a project-specific work plan (and the rationale for such a decision must be provided), an unfiltered sample should always be collected for analysis in addition to the filtered sample.

Whenever possible, an in-line filter should be used to filter groundwater samples as the water is withdrawn from the well. The selection of which, if any, filter should be used depends on the data quality objectives for the project and will be specified in the QAPP and/or site-specific work plan. A 0.45-micron filter is used for samples for which the objective is to obtain results for dissolved constituents (usually metals). A 10-micron filter is used to distinguish analytical results for dissolved plus colloidal constituents vs. analytical results that include constituents that might be absorbed onto fine-grained particles that are present in the water sample.

In some cases, water samples other than groundwater samples must be filtered in the field prior to sample collection into appropriate sampling bottles. To accomplish this, a sample of the water to be filtered is collected into a clean container with sufficient volume to fill all sampling containers for which a filtered sample is necessary. If electric power is unavailable, battery packs are required to operate the peristaltic pump. A ring stand with clamp to hold the in-line filter is optional but may be useful.

The procedure for filtration of water samples from a source other than a monitoring well is as follows:

- A sufficient length of new Tygon™ tubing (or tubing of other appropriate inert material) is inserted into a peristaltic pump.
- The input end of the tubing is then inserted into the unfiltered water sample, and an in-line filter (0.45-micron or 10-micron filter, as appropriate, depending on the objective for the sampling event) is inserted into the output end of the tubing.
- An additional length of tubing is connected to the other end of the in-line filter to better direct the filtered water into the sample bottle(s). The flow direction shown on the filter must match the actual flow direction.
- Once the in-line filter is placed over the sample container, the pump is then turned on and run until sample collection is complete.

As noted above for filtration of groundwater samples from monitoring wells, the selection of which, if any, filter should be used depends on the data quality objectives for the project and will be specified in the QAPP and/or site-specific work plan.

4.2 Compositing

Compositing of samples for investigation purposes is strongly discouraged. Therefore, compositing of soil or water should only be performed if specifically indicated in the project-specific work plan, and the specific rationale and approach to compositing should be clearly described in that document.

However, compositing of similar materials for the purposes of obtaining waste disposition approvals is generally acceptable, and often required. Careful consideration should be given to the objectives of the sampling before collection of any composite sample is performed.

Those soil samples to be analyzed for non-volatile parameters may be mixed in any convenient, clean container. Soil samples to be analyzed for volatile organic compounds should not be composited.

For waste oil and other wastes, only those of similar appearance (color, viscosity, suspended material, odor if determined) should be composited. Liquid samples may be composited by pouring the appropriate percentages into the sample container to be sent to the laboratory.

4.3 Chain-of-Custody Procedures

4.3.1 Chain-of-Custody Form

A copy of a representative chain-of-custody form is provided in Attachment A. The sampler must fill in all relevant information as indicated on the form, including the "laboratory preparation" section. Any preparation required should be indicated on the form. The sampler must sign the form in the space indicated, including data and time of transfer, when relinquishing samples to another individual or to the laboratory. Each successive handler of the samples must also sign the form with data and time when relinquishing samples, and the receiving entity must acknowledge receipt.

4.3.2 Sample Labeling Nomenclature

Samples shall be labeled with the following information:

- Date
- HRP
- HRP Job #
- Sample identification. Samples from test borings must have, in addition to the test boring identification, the depth from which the sample was retrieved.
- Special labeling requirements may also be required for certain jobs. These requirements should be detailed in the QAPP and/or project-specific work plan.

4.3.3 Delivery/Receipt Procedures

As noted above, the chain-of-custody forms must be signed by both the person delivering the samples and the person receiving them. The time and date of transfer must be indicated.

5.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

5.1 Blanks

Field, trip, and equipment blanks are slightly different from one another. For preparation of an equipment blank, an appropriate blank material (deionized water) is brought in contact with the pre-cleaned sampling tools used for "real" samples. Equipment blanks, in theory, indicate whether the sampling equipment has been properly decontaminated. Field blanks are prepared by carrying the blank material to the sampling site and placing it in appropriate containers. Field blanks are used to determine whether airborne contamination is present at the sampling site. Field blanks are collected only when airborne contamination is suspected. Trip blanks are prepared at the analytical laboratory and transported to the site in sealed containers. They are used to evaluate the potential for contamination that may be attributed to shipping and handling procedures. Temperature blanks are prepared prior to sampling. They document the temperature preservation of samples upon receipt at the laboratory.

Blank samples are typically used for quality control and quality assurance. They provide qualitative information concerning contamination, handling and shipping procedures which may affect the quality of data that is collected. The rate at which blank samples are collected depends on the DQOs established for the project, but are typically prepared at a rate of 5% (i.e., 1 per 20 samples). For VOC analyses, trip blanks are prepared at a rate of 1 per shipping container in which samples for VOC analysis are transported. In some cases, blank samples may be collected at a rate of 1 per day if less than 20 samples have been collected. A group of samples that are transported together generally constitutes the sample delivery group (SDG). Specific requirements for collection of blank samples should be provided in the project-specific QAPP and work plan.

Water: Water for blanks shall consist of analyte-free water. The blank sample should be collected in the same kind of container used for the other water samples. Blank samples should be given plausible "well" identifications such as "MW-28". Trip blanks are typically analyzed only for VOCs. Analysis of equipment and field blanks are generally determined on a site-by-site basis or as specified in a site-specific work plan or QAPP.

Soil: Due to difficulties in preparing representative samples, blanks comprised of soil are uncommon.

5.2 Duplicates

True duplicates of samples cannot really be obtained, but replicate samples (which are commonly referred to as “duplicates”) should be collected as near as possible, both in time as well as space, to their principal samples. Depending on project objectives, sampling identification may indicate to the laboratory that the sample is a duplicate of another sample or the sample may be submitted to the laboratory as a “blind duplicate,” i.e., with no indication in the sample identifier that the sample is a duplicate or replicate of another sample.

Information regarding the collection of duplicate samples will be specified in the QAPP and/or project-specific work plan.

6.0 REFERENCES

New York State Department of Environmental Conservation (NYSDEC). 2010. *DER-10, Technical Guidance for Site Investigation and Remediation*, Division of Environmental Remediation. May 2010.

NYSDEC, Technical Procedure Guidance, Quality Assurance/Quality Control Procedures, *Spill Guidance Manual*, Section 2.4.

USEPA. 2015*. Standard Operating Procedure - Sample Receiving, Handling, and Storage,* SERAS SOP No. 1008, Rev. 2.1, Scientific, Engineering, Response and Analytical Services, December 9, 2015*.*

ATTACHMENT A

Representative Chain-of-Custody Form

con-test ANALYTICAL LABORATORY

Phone: 413-525-2332
Fax: 413-525-6405
Email: info@contestlabs.com

CHAIN OF CUSTODY RECORD

39 Spruce Street
East Longmeadow, MA 01028

Page _____ of _____

Company Name:
Address:
Phone:
Project Name:
Project Location:
Project Number:
Project Manager:
Con-Test Quote Name/Number:
Invoice Recipient:
Sampled By:

Requested Turnaround Time
7-Day ☐ 10-Day ☐
Due Date:

Rush-Approval Required
1-Day ☐ 3-Day ☐
2-Day ☐ 4-Day ☐

Data Delivery
Format: PDF ☐ EXCEL ☐
Other:
CLP Like Data Pkg Required: ☐
Email To:
Fax To #:

ANALYSIS REQUESTED

# of Containers
[2] Preservation Code
[3] Container Code

Dissolved Metals Samples
○ Field Filtered
○ Lab to Filter

Orthophosphate Samples
○ Field Filtered
○ Lab to Filter

Con-Test Work Order#	Client Sample ID / Description	Beginning Date/Time	Ending Date/Time	Composite	Grab	[1]Matrix Code	Conc Code											

Comments:

Please use the following codes to indicate possible sample concentration within the **Conc Code** column above:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

[1] **Matrix Codes:**
GW = Ground Water
WW = Waste Water
DW = Drinking Water
A = Air
S = Soil
SL = Sludge
SOL = Solid
O = Other (please define)

[2] **Preservation Codes:**
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium Bisulfate
X = Sodium Hydroxide
T = Sodium Thiosulfate
O = Other (please define)

[3] **Container Codes:**
A = Amber Glass
G = Glass
P = Plastic
ST = Sterile
V = Vial
S = Summa Canister
T = Tedlar Bag
O = Other (please define)

Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:
Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:
Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:

Detection Limit Requirements
MA
CT
Other:

Special Requirements
☐ MA MCP Required
MCP Certification Form Required
☐ CT RCP Required
RCP Certification Form Required
☐ MA State DW Required
PWSID #

con-test ANALYTICAL LABORATORY
www.contestlabs.com

NELAC and AIHA-LAP, LLC Accredited

Project Entity
☐ Government ☐ Municipality ☐ MWRA ☐ WRTA
☐ Federal ☐ 21 J ☐ School
☐ City ☐ Brownfield ☐ MBTA

Other
☐ Chromatogram
☐ *AIHA-LAP,LLC*

PCB ONLY
☐ Soxhlet
☐ Non Soxhlet

Recommended Containers, Preservation, Storage, & Holding Times For Water, Drinking Water, and Wastewater

Description	Method	Matrix	Sample container	Preservative	Prep/Analysis Holding Time	Volume
Organic Analyses						
EDB, DBCP	504.1	H_2O	40ml Vial Teflon septa	Cool 4^{0}C $Na_2S_2O_3$	14 days	40 ml
GCMS - Volatiles	524.2	H_2O	40ml Vial Teflon septa	Cool 4^{0}C Ascorbic acid & HCL to pH<2	14 days	40 ml
	624, 8260	H_2O	40ml Vial Teflon septa	Cool 4^{0}C HCL to pH<2	14 days	40 ml
GC-Pesticides & PCBs	608	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C NaOH or H_2SO_4 to pH 5-9	7/40 days	1 Liter
GC-Pesticides & PCBs	8081, 8082	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
GC/MS-Semivolatiles - PAH's Base Neutral/Acid Extractables	625, 8270	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
Petroleum Hydrocarbons						
Oil & Grease	1664	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C H_2SO_4 to pH<2	28 days	1 Liter
Diesel Range Organics (DRO)	Modified 8015B	H_2O	Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
Gasoline Range Organics (GRO)	Modified 8015B	H_2O	Glass Teflon Cap	Cool 4^{0}C HCL to pH<2	14 days	40 ml
Total Petroleum Hydrocarbons (TPH) by GC	Modified 8100	H_2O	Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
MA DEP VPH	98-1	H_2O	40ml Vial Teflon septa	Cool 4^{0}C 3-4 drops of 1:1HCL	14 days	40 ml
MA DEP EPH	97-12	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C 5 ml of 1:1HCL	14/40 days	1 Liter
CT ETPH	CT ETPH	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C	14/40 days	1 Liter
Metals						
ICP/ICPMS Metals	200.7/200.8 6010/6020	H_2O	Plastic / Glass	Cool 4^{0}C HNO_3 to pH<2	6 months	DW-1L WW-250ml
Mercury (Hg)	245.1/7470A	H_2O	Plastic / Glass	Cool 4^{0}C HNO_3 to pH<2	28 days	DW-1L WW-250ml
Chromium VI (Cr^{+6})	SM 3500 Cr D	H_2O	Plastic / Glass	Cool 4^{0}C	24 hours	200 ml
Chromium VI (Cr^{+6})	SW-846 7196A	H_2O	Plastic / Glass *	Cool 4^{0}C	24 hours	200 ml
Inorganic/Wet Chemistry						
Alkalinity	SM 2320B	H_2O	Plastic / Glass *	No Headspace Cool 4^{0}C	14 days	250 ml
BOD	SM 5210B	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	1 Liter
Chloride	SM 4500 Cl B	H_2O	Plastic / Glass	Not Required	28 days	250 ml
Chlorine, Total Residual	SM4500 Cl G	H_2O	Plastic / Glass	Not Required	Analyze immediately	250 ml
COD	410.4/Hach 8000	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	250 ml
Coliform, Fecal	SM 9222D	H_2O	Sterile Plastic	Cool 4^{0}C	6 hours	100 ml
Coliform, Total	SM 9222B	H_2O	Sterile Plastic	Cool 4^{0}C	30 hours	100 ml
E. Coli confirmation	SM 9222G	H_2O	Sterile Plastic	Cool 4^{0}C	30 hours	100 ml
Heterotropic Plate Count	SM 9215B	H_2O	Sterile Plastic	Cool 4^{0}C	8 hours	100 ml
Inorganic/Wet Chemistry (continued)						
Color	SM 2120B	H_2O	Sterile Plastic	Cool 4^{0}C	48 hours	200 ml
Conductance	SM 2510B	H_2O	Plastic / Glass	Cool 4^{0}C	28 days	100 ml
Cyanide, Amenable	SM4500 Cn-C,E	H_2O	Amber Glass	Cool 4^{0}C NaOH to pH>12	14 days	500 ml
Cyanide, Free	SM4500 Cn-C,E	H_2O	Plastic / Glass	Cool 4^{0}C NaOH to pH>12	14 days	500 ml
Cyanide, Total	SM4500 Cn-C,E	H_2O	Plastic / Glass	Cool 4^{0}C NaOH to pH>12	14 days	500 ml
Flashpoint	SW 846 1010	H_2O	Plastic / Glass	Cool 4^{0}C	ASAP	50 ml
Flouride (drinking water)	SM 4500F-C	H_2O	Plastic / Glass	Not Required	28 days	200 ml
Hardness	SM 2340C	H_2O	Plastic / Glass	Cool 4^{0}C	6 months	250 ml
MBAS (Surfactants)	SM5540C	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	250 ml
Nitrogen, Ammonia	SM 4500 NH3C	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	250 ml
Nitrogen, Total Kjeldahl	SM 4500-N Org B, C,	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	500 ml
Nitrogen, Nitrate	SM 4500 NO3 F	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	48 hours / 28 days preserved	250 ml
Nitrogen, Nitrite	SM 4500 NO2 B	H_2O	Plastic / Glass	Cool 4^0 C	48 hours	100 ml
Nitrogen, Nitrate + Nitrite	SM 4500 NO3 F	H_2O	Plastic / Glass	Cool 4^0 C H_2SO_4 to pH<2	48 hours / 28 days preserved	100 ml
Odor	SM 2150B	H_2O	Plastic / Glass	Cool 4^{0}C	24 hours	500 ml
Orthophosphate	SM 4500 P E	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	100 ml
Oxygen, Dissolved	SM 4500 O-C1 SM S210B	H_2O	Plastic / Glass with glass top	Cool 4^{0}C	Analyze immediately	300 ml
pH, Hydrogen ion	SM 4500 H-B	H_2O	Plastic / Glass	Not Required	Analyze immediately	25 ml
Phenolics	420.1	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	1 Liter
Phosphorous, Total	SM4500P-E	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	500 ml
Total Dissolved Solids (TDS)	SM 2540C	H_2O	Plastic / Glass	Cool 4^{0}C	7 days	300 ml
Total Suspended Solids (TSS)	SM 2540D	H_2O	Plastic / Glass	Cool 4^{0}C	7 days	300 ml
Settleable Solids	SM 2540 F	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	1 Liter
Sulfate	ASTM DS16-90	H_2O	Plastic / Glass	Cool 4^{0}C	28 days	300 ml
Sulfide	SM 4500 S2,E	H_2O	Plastic / Glass with Glass top	Cool 4^{0}C NaOH to pH>9 2N Zn Acetate	Analyze immediately	500 ml
Sulfite	377.1 / SM 4500 SO3	H_2O	Plastic / Glass	Not Required	Analyze immediately	100 ml
Total Organic Carbon (TOC)	SM S310B	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C HCL to pH<2	28 days	100 ml
Turbidity	180.1 / SM 2130 B	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	100 ml

Recommended Containers, Preservation, Storage, & Holding Times For Soil, Solids, and Other Wastes

Description	Method	Matrix	Sample container	Preservative	Prep/Analysis Holding Time	Volume
Organic Analyses						
GCMS - Volatiles	8260B	Soil/Waste	Glass w/ Teflon Septa	Cool 4^{0}C 15 ml CH_3OH or 5 ml NaHSO4 5 or ml DI H_2O	14 days	15g or 5g or 5g
GC-Pestacides & PCBs	8081A/8082	Soil/Waste	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
GC/MS-Semivolatiles - PAH's Base Neutral/Acid Extractables	8270C	Soil/Waste	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	Modified 8015B	Soil	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
Gasoline Range Organics (GRO)	Modified 8015B	Soil	Glass w/ Teflon Septa	Cool 4^{0}C 15 ml CH_3OH	14 days	15 grams
Total Petroleum Hydrocarbons (TPH) by GC	Modified 8100	Soil	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
MA DEP VPH	98-1	Soil	40ml Vial Teflon septa	Cool 4^{0}C 15 ml CH_3OH	14 days	15 grams
MA DEP EPH	97-12	Soil	Amber Glass Teflon Cap	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
CT ETPH	CT ETPH	Soil	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
Metals						
ICP Metals	6010	Soil	Plastic / Glass	Cool 4^{0}C	6 months	100 g or 8oz Jar
Chromium VI (Cr^{+6})	SW-846 7196A	Soil	Plastic / Glass *	Cool 4^{0}C	24 hours	(2) - 2oz Jars
Mercury (Hg)	7471	Soil	Plastic / Glass	Cool 4^{0}C	28 days	100 g or 8oz Jar
Inorganic/Wet Chemistry						
General Inorganics	9000 Series	Soil	Glass Teflon Cap	Cool 4^{0}C	See Table 1.	100 g or 8oz Jar
Flashpoint/Ignitibility	1010	Soil	Glass Teflon Cap	Cool 4^{0}C	ASAP	100 g or 8oz Jar
pH/Corrosivity	9045C	Soil/Waste	Plastic / Glass	Cool 4^{0}C	ASAP	100 g or 2oz Jar
Reactivity	SW 846 (7.3)	Soil/Waste	Plastic / Glass	Cool 4^{0}C	ASAP	100 g or 8oz Jar
TCLP/SPLP	1311/1312	Soil/Waste	Glass Teflon Cap	Cool 4^{0}C	Varied	500g or 32 oz Jar
TCLP/SPLP	1311/1312	Soil/Waste	Glass Teflon Cap	Cool 4^{0}C	Varied	500g or 32 oz Jar

* Requires it's own container

Revised 04.05.10

con-test®
ANALYTICAL LABORATORY

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Low-flow Groundwater Sampling

SOP #107

Revision Date: August 8, 2019

LIST OF REVISIONS

Date	Summary of Changes	Approval
	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

Technical Director/
HRP Quality Assurance Officer

Gail L. Batchelder
Gail L. Batchelder, Ph.D., P.G., L.E.P.

August 8, 2019
Date

Vice President/
Practice Leader - Environmental

Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

This Standard Operating Procedure (SOP) provides the general procedures for Low-flow Groundwater Sampling for environmental investigation- and remediation-related activities. The SOP was developed based on a number of sources that represent prevailing standards and guidelines typically used in the field of environmental investigation and remediation. However, the procedures described herein are not intended to supersede any applicable local, State or Federal regulations. Nor can the procedures described in this SOP take into account every condition that might be encountered in the field or every project-specific data quality objective. An important component of this SOP is the need to document those instances where the procedures described herein are not followed for a specific project, the rationale for not following the procedures described in the SOP, and a description of the alternative procedures that were used instead.

1.0 INTRODUCTION

This SOP describes a low-flow, low-stress methodology for collecting groundwater samples in a manner that minimizes turbidity during sampling and improves the likelihood of collecting samples that are representative of groundwater quality in the aquifer at ambient flow conditions. The SOP was developed in general accordance with the U.S. EPA Region I SOP #GW 0001 rev. 2: *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitor Wells*, July 30, 1996, as well as other U.S. EPA protocols and guidance. The sampling protocol emphasizes the need to minimize changes to water chemistry by maintaining minimal water-level drawdown and flow rates during the sampling process. The low-flow protocol was originally developed by EPA for the collection of groundwater samples for analysis for total (unfiltered) metals, but can also be applied to samples collected for analysis volatile and semivolatile organic compounds, total petroleum hydrocarbons, herbicides/pesticides, polychlorinated biphenyls (PCBs), inorganic constituents, and other analytes.

This procedure may not be appropriate for collecting samples from wells containing non-aqueous phase liquids (NAPLs) or wells in which drawdown of the water level cannot be controlled under minimal stress conditions.

The applicability of this SOP to meet sampling data quality objectives must be evaluated the project manager prior to initiating sampling activities. Furthermore, the relevance of this sampling methodology must be considered on an individual project-specific basis in careful consideration of the regulatory authority involved (e.g., state agency vs. United States Environmental Protection Agency) and the overall objectives for the sampling effort. As with all standard operating procedures, careful consideration must be given to the equipment used, the field parameters to be measured, and the analyses to be performed to ensure that data quality objectives for the project will be met.

Attached to this SOP is a Monitoring Well Data Sheet, which must be completed for each well at the time of sampling. Also attached to this SOP is a Low-Flow Groundwater Sampling Work Scope Summary form. The purpose of this form and supporting documentation is to specify the equipment, stabilization parameters, and site-specific information necessary to support the decision-making process used during the sampling event(s). This summary is intended to accompany the low-flow sampling SOP and must be completed for each project in which low-flow sampling will be conducted.

1.1 Equipment List

- Extraction Device (pumps)

Groundwater purging and sampling will be conducted using a variable speed pump. The type of pump used will depend on the sampling objectives, target analytes, and depth to water in the well. The types of pumps that might be considered include:

  - **Variable speed, positive displacement or submersible pumps** - Applicable to wells with shallow or deep groundwater elevations. Includes centrifugal or bladder pumps constructed of stainless steel or Teflon.
  - **Variable speed, peristaltic pumps or suction pumps** – Applicable to wells in which the measured groundwater elevation is less than approximately 20 to 25 feet from the top of the well.

- Tubing
  - **Polyethylene tubing (1/4-inch outer diameter)**. An equipment blank (which includes the tubing) should be collected for sampling events in which one or more groundwater samples will be analyzed for volatile organic compounds in order to demonstrate that the tubing materials do not add contaminants to the sample.
  - **Tygon® tubing (1/4-inch inner diameter)** for groundwater sample collection when phthalates are a known constituent of concern. An equipment blank should be collected for analysis for phthalates.

A 12” length of ¼-inch inner diameter pharmaceutical grade CFLEX®, Tygon®, or silicon tubing for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.

- Electronic water-level measuring device, capable of measuring to 0.01’ accuracy.
- Flow measurement supplies – 120 milliliter (ml) calibrated plastic beaker, graduated cylinder, or equivalent, and stop watch.
- Power sources (at least one of the following) –
  - available 110V AC electrical source
  - lead/acid automobile battery
  - alternative field battery pack
  - gasoline-fueled generator – must be located >30’ downwind from well(s)
- Compressed air or nitrogen source, if needed to operate the pump selected
- Use of a flow-through cell is strongly recommended to measure specific field parameters (temperature, pH, specific conductance, oxidation-reduction potential, dissolved oxygen) during purging.
- Turbidimeter to measure turbidity in the field
- Meter calibration supplies
- Decontamination supplies
  - solution of Liquinox™ with tap water or Alconox™ for mixing
  - <10% methanol/water solution
  - <10% nitric acid/water solution
  - Deionized water
  - 5-gallon buckets

  - Logbook(s) and Low-Flow Groundwater Sampling form
  - Sample bottles – appropriate for the analyses to be conducted
  - Sample preservation supplies (as required by the analytical methods), if not pre-supplied by laboratory in sampling containers.
    - Nitric acid (metals)
    - Hydrochloric acid (VOCs)
- Container labels
- Well keys
- Personal protection equipment (PPE)
- Tool kit (wrenches, pliers, etc.)
- Cooler with ice (**strongly recommended**) or ice packs
- Container(s) for purge and decontamination fluids, as applicable

1.2 Documentation

- Site plan
- Health & Safety Plan (HASP)
- Site-specific Work Plan
- Quality Assurance Project Plan (QAPP), as applicable
- Monitoring Well Data Sheet(s)
- Sample Log
- Sample collection sheet
- Notebook - sketch pad
- Chain of custody record

2.0 PROCEDURE

2.1 Preliminary Activities

1. Review information from previous investigations, HASP, and site-specific Work Plan, as well as the project-specific QAPP, as applicable, prior to performing any field activity to understand the site history, possible chemical and physical hazards, anticipated groundwater quality, any potential or known releases, and well development history and previous groundwater sampling records.
2. Pre-label sampling jars, if acceptable, given knowledge of the site, particularly if the site monitoring wells have been previously sampled. Also, the sampling jars can be pre-preserved in advance as appropriate for the requisite analytical parameter(s). Often the laboratory will provide pre-preserved sampling containers.
3. Check well for security damage, evidence of tampering, condition of well casing, condition of surface seal, and/or presence of insects/wasps/spiders, etc. and record pertinent observations.

4. Lay out sheet of clean polyethylene for monitoring and sampling equipment or use other appropriate containment strategy, such as a clean plastic tub, to protect sampling equipment and contain potential releases.
5. Check monitoring wells for the presence of LNAPL before each sampling round if separate-phase product is a potential based on the substances that may have been released at the site or in the vicinity. Checking wells for the presence of DNAPL must only be performed after samples have been collected from the well to minimize disturbance to the water column prior to sampling.
6. Perform a complete round of water-level measurements round (to the nearest 0.01 foot) in the shortest possible time before any purging and sampling activities begin. This complete round of water-level measurements is a separate event from the measurement of water levels associated with the sampling at each well.

   For capped wells, allow at least 15 to 20 minutes between opening the well and recording of the water level to allow for equilibration of water levels after the well is opened. Minimize water column disturbance. **Measurement of total well depth (to 0.01 foot) is measured after sampling of the well is complete** to minimize disturbance of the water column if the complete round of water-level measurements is performed the same day as groundwater sampling**.**

   All measurements must be taken from an established reference point marked on top of well casing, usually at the highest point of the case or the north center of the casing. Depth-measuring equipment must be decontaminated after measurement of each well. All measurements that are not consistent with prior data should be immediately recorded a second time in order to confirm and document the accuracy of the measurement.

   For low-flow, low-stress sampling events conducted after the first such sampling event from the monitoring well network, water levels measured during the subsequent water-level measurement rounds should be compared to those from prior events to determine the appropriate sampling depths and sampling rates. Efforts should be made to duplicate, to the extent practicable, the intake depth and extraction rate (using the final pump dial setting information) from previous event(s).
7. Field-calibrate meters per manufacturer's specifications. Calibrate instruments at the beginning of each day and perform calibration checks at the middle and end of each day. If calibration check does not indicate the expected reading (within the range specified by the manufacturer), recalibrate the instrument. If it is determined that the meter will not hold calibration, contact the HRP project manager who should authorize one of the following options: a) sampling with a replacement meter that is calibrated properly; b) ceasing the sampling event; or c) continuing to sample with the meter without recording the parameter(s) that will not properly calibrate.

2.2 Purging and Sampling Procedures

Installing Tubing or In-well Pump

Peristaltic Pump

Prepare the pump by placing the CFLEX®, Tygon®, or silicon tubing around the rotor and connecting the tubing that will be placed into the well to the tubing around the rotor.

Lower the in-well tubing slowly into the well (to minimize disturbance of the water column) until the tubing intake is placed at the depth designated to accomplish the site-specific investigation objectives or any state or region-specific requirements. Measure the depth to which the tubing is lowered carefully, to avoid having the end of the tube hit the bottom of the well and If possible, keep the bottom of the tubing at least two feet above the bottom of the well to minimize mobilization of particulates present in the bottom of the well.

The mid-point of the saturated screen length is often used as the location of the pump intake, *unless otherwise specified in the project-specific Work Plan or QAPP*. Should an alternative location/depth be used for the pump intake, the rationale should be clear and carried through the project unless directions to the contrary are provided by the project manager. If the water column in the well is less than 3 feet, particular care must be taken to keep the end of the tubing from being lowered to less than one foot above the bottom of the well, even if the objective of setting the tubing intake at a the mid-point of the saturated portion of the screen cannot be met.

In-well Pump

Lower pump, safety cable, tubing and/or electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The intake point of the pump is placed at a depth capable of accomplishing the site-specific investigation objectives. The mid-point of the saturated screen length is often used as the location of the pump intake, *unless otherwise specified in the project-specific Work Plan or QAPP*. If possible, keep the pump intake or pump bottom, whichever is lower, at least two feet above the bottom of the well to minimize mobilization of particulates present in the bottom of the well.

Measurement of Water Levels

Measure the water level in the well after the level has equilibrated following introduction of equipment into the well. Water levels should be measured in each well just prior to initiating purging using the measurement techniques described in Section 2.1 for the complete water-level measurement round.

Purging Well

1. Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no drawdown in water level (i.e., less than 0.3 feet) and the amount of drawdown remains stable If the minimal drawdown that can be achieved at the lowest pump setting exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize. Do not allow the water level to be drawn down below the pump intake.

2. Monitor and record water level and pumping rate every five minutes during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should be adjusted to the maximum flow rate that the well can sustain while maintaining drawdown at 0.3' or less. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screened interval).

3. The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume:

$$V_P > 28.32 ((3.14*r_t^2 l_t) + (3.14*r_w^2 h_w))$$

Where,

V_P = purge volume (milliliters)
r_t = inner diameter of sampling tube (0.021 feet for ¼” tubing)
l_t = length of sampling tube (feet)
r_w = Radius of the monitor well (0.083 feet for 2” PVC well)
h_w = Change in water level elevation or stabilized depth to water minus the initial depth to water (feet)

Change in Head Volumes			
Well Dia.	Vol./ft (mL)	Vol./ft (L)	Vol./ft (gal)
1"	154	0.15	0.04
2"	620	0.62	0.16
4"	2,471	2.47	0.65
6"	5,560	5.56	1.47
Tubing Volumes			
Tubing ID	Vol./ft (mL)	Vol./ft (L)	Vol./ft (gal)
0.17"	4.5	0.004	0.001
0.19"	5.6	0.006	0.0015
0.25"	9.7	0.010	0.003
0.375"	21.7	0.022	0.006

4. If the drawdown does not stabilize at 0.3 feet or less at the lowest possible flow rate, the well may be sampled as soon as the water level has recovered, provided that the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized. The following table indicates the necessary sample volumes based on the well diameter and volume of the sample container.

Sample Container Vol (ml)	**well diam (inch)**	**Minimum water column height to fill sample container**	
		inches	**feet**
40	2	0.78	0.1
250	2	4.86	0.4
1000	2	19.42	1.6
40	1	3.11	0.3
250	1	19.42	1.6
1000	1	77.70	6.5
40	0.75	5.53	0.5
250	0.75	34.53	2.9
1000	0.75	138.13	11.5

2.3 Monitoring Field Indicator Parameters

Monitor indicator field parameters (turbidity, temperature, specific conductance, pH, oxidation/reduction potential [ORP], dissolved oxygen [DO]) every five minutes during well purging. Should conditions exist at a specific well where such monitoring is not feasible due to low yield of the well, the conditions must be thoroughly documented, and an alternative approach may be used after consultation with the project manager. However, during the very early stage of purging, emphasis should be minimizing and stabilizing pumping stress, and recording those adjustments to document stability of water levels and demonstrating that the pumping rate is within the specified limits. Purging is considered complete and sampling may begin when the indicator field parameters have stabilized. Stabilization is considered to be achieved when at least three consecutive readings, taken at five-minute intervals, are within the following limits for the measured parameters (or other parameters established by state-specific or region-specific requirements):

- pH (± 0.1 unit)
- Temperature (3%)
- Specific conductance (3%)
- DO (10%)
- ORP/Eh (± 10 millivolts)
- Turbidity (10% for values greater than 1 NTU).

The order in which the above parameters will stabilize is dependent on a number of factors including, but not limited to, aquifer matrix, well screen and filter-pack design, and whether the well has been developed. **Turbidity is often the last parameter to stabilize**.

Use a flow-through cell to obtain measurements of any indicator field parameter, except turbidity. Transparent flow-through cells are preferred, because they allow field personnel to monitor particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell. Such build-up may also affect turbidity values if the sample aliquot used to measure turbidity is collected after moving through the flow-through cell. Therefore, aliquots of groundwater used to measure turbidity should be collected from water that has not yet entered the flow-through cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and note monitoring activities.

When measuring parameters other than turbidity, a flow-through cell that prevents air bubble entrapment in the cell should be used. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times during operation. If two flow-through cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system). If there are state-specific or region-specific requirements for measurements of any parameter, such as the use of down-hole equipment, explanations must be provided. The use of any down-hole measurement instruments can be particularly problematic, since the lowering of any instrument, tubing, or measurement device through the water in the well has the potential to disturb the water column, which is counter to the intent of low-flow, low-stress sampling, which is an undisturbed water column. Therefore, if such activity is required, special care must be taken to minimize disturbance of the water column prior to sample collection.

2.4 Collecting Water Samples

1. Collect the water samples for laboratory analyses before water has passed through the flow-through cell (use a by-pass assembly or disconnect cell to obtain sample).
2. Collect VOC samples first and directly into 40-ml sample vials pre-preserved with hydrochloric acid. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence to result in no bubbles in the vial when capped.
3. During purging and sampling, maintain the tubing such that it is filled with water in order to minimize possible changes in water chemistry upon contact with the atmosphere. Use tubing with 1/4” inner diameter to help insure that the sample tubing remains water-filled. If the pump tubing is not completely filled to the sampling point, add a clamp to constrict sampling end of tubing.
4. Label each sample as collected unless samples are pre-labeled. Samples requiring cooling (VOCs, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory.

2.5 Post-Sampling Activities

- As determined by the work scope and data quality objectives, the pump and/or tubing may either be dedicated to the well for re-sampling or removed after collection of the samples. Tubing removed from a well after sampling should be properly discarded immediately after use.
- Following sample collection, measure depth to the bottom of the well (to 0.01 foot) and record the well depth on the Monitoring Well Data Sheet.
- Secure the well
- Decontaminate sampling equipment as indicated below in Section 2.6.

2.6 Decontamination Procedures

- The HRP representative will ensure that all necessary non-disposable sampling equipment that is n contact with the well is decontaminated prior to use in the first well and following sampling of each subsequent well in accordance with the following procedures.
- Decontamination procedures may vary slightly from those presented below, dependent upon the particular types of contaminants encountered

- Decontamination Supplies
  - Solution of Alconox™ and water prepared in a 5-gallon bucket (approximately 2.5 gallons). Another 5-gallon bucket will contain potable water (approximate 2.5 gallons).
  - Deionized water
  - 5-gallon buckets
  - Spray bottles
  - Brushes
  - Paper towels
  - Isopropyl alcohol/water solution (as appropriate based on contaminants and analyses to be performed)
  - <10% nitric acid/water solution (as appropriate based on contaminants and analyses to be performed)
- Sampling Devices (typically split spoons or Macro-Core®-type sampling devices) will be decontaminated between each sample. The order of decontamination solutions and procedures for split-spoon and other multi-use sampling devices is as follows:
- Decontamination will be conducted in the following order:
  - Wipe or scrub excess dirt from equipment, as needed, using brush or paper towels
  - Rinse/scrub in potable water (in a 5-gallon bucket) to remove additional loose debris, as necessary
  - Wash in a solution of Alconox™ and potable water (in a 5-gallon bucket)
  - Rinse with potable water
  - Rinse with analyte-free water
- The following steps may be required by a QAPP or project-specific Work Plan, by a regulatory agency, or necessary due to the nature of the contaminants:
  - Spray with <10% isopropyl/water solution when organics are potential constituents of concern
  - Rinse with potable water
  - Rinse with <10% nitric acid/water solution when metals are potential constituents of concern
  - Rinse with potable water
  - Rinse with deionized water
  - Wipe with a clean paper towel (optional, depending on weather conditions)
  - Air Dry (as appropriate)

Alternative methods of cleaning may more appropriate (or necessary) for an individual pieces of equipment, based on site conditions, site contaminants, Quality Assurance Project Plan (QAPP), or site-specific work plan requirements, Alternative decontamination solutions must be consistent with overall objectives for the project, and use of alternative decontamination solutions or decontamination procedures must be made after consultation with the HRP project manager and must be documented in field paperwork as to rationale and appropriateness. Decisions regarding alternative decontamination procedures or solutions must be made in coordination with the HRP Project Manager and/or Quality Assurance Officer for the project.

At the end of the project day, all HRP equipment which is used on the site shall be decontaminated. Disposal of all spent decontamination solutions shall be in accordance with the requirements of the site work plan and state and federal requirements.

3.0 FIELD QUALITY CONTROL

- Collect quality control samples according to the project-specific QAPP or work plan. All field quality control samples must be prepared the same manner as regular investigation samples with respect to sample volume, containers, and preservation. As an additional quality assurance approach, collect samples in order -- from wells with lowest contaminant concentration to those with the highest concentration, if such information is known or can be anticipated. Collect equipment blanks after sampling from contaminated wells and not after background wells.
- Operate all monitoring instruments in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846 with exception of ORP, for which the manufacturer's instructions are to be followed.
- Where used, instruments shall be calibrated at the beginning of each day and a calibration check should be conducted at the middle and end of each day, or whenever measurements appear anomalous. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. Instruments used to measure temperature (i.e., thermometers and thermistors) need not be calibrated with the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

4.0 DOCUMENTATION

- Document all groundwater field monitoring activities (see attached matrix) in a field log that includes the following:
  - Job Number
  - Site location
  - Date of sampling
  - Weather conditions
  - Field personnel
  - Objective of visit
  - Well identification
  - Well depth and measurement technique (list any measurement correction factors)
  - Static water-level depth, date, time and measurement technique. Presence and thickness of immiscible liquid (NAPL) layers and detection method

        - Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped
        - Well sampling sequence and time of each sample collection
        - Types of sample bottles used and sample identification numbers
        - Preservatives used
        - Parameters requested for analysis
        - Field observations during sampling event
        - Name of sample collector(s)
        - Equipment cleaning and calibration information
        - QA/QC data for field instruments
        - Description of all sampling equipment used
    - Any problems encountered should be identified, and methods taken to minimize or correct problems should be documented.
    - All deviations from sampling procedures outlined in the SOP and/or work plan, including rationale for any modifications and potential impact on data quality objectives for the sample(s).
    - Complete all data reporting in accordance with the project-specific QAPP and/or work plan.

5.0 REFERENCES FOR LOW-FLOW GROUNDWATER SAMPLING PROCEDURES

New York State Department of Environmental Conservation (NYSDEC). 2010. *DER-10, Technical Guidance for Site Investigation and Remediation*, Division of Environmental Remediation. May 2010.

Puls, R.W. and Barcelona, M.J. 1996. *Low-flow (minimal Drawdown Groundwater Sampling Procedures*, Ground Water Issue, U.S. EPA, EPA/540/S-95/504, April 1996.

USEPA Region I. 2010. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells*, Region 1 SOP rev. 3, July 30, 1996, rev. January 19, 2010.

USEPA Region 4. 2013. *Groundwater Sampling*, SESDPROC-301-R3, SESD Operating Procedure, Region 4 SOP rev. 3, March 6, 2013.

USEPA, Region 4. 2015. *Operating Procedure: Field Equipment Cleaning and Decontamination*. SESDPROC-205-R3. Science and Ecosystem Support Division. Athens, GA.

Yeskis, D. and Zavala, B. (2002). *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers*, U.S. EPA Office of Solid Waste and Emergency Response, EPA 542-S-02-001, May 2002.

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Farmington, Connecticut 06032
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Monitor Well Data Sheet

Page ____ of ____

Well ID:

Site Background Information

Site Location:		**Sampling Dates:**	
Job Number:		**Field Team Leader:**	
Weather:		**Team Personnel:**	

Ground Water Elevation Data

Date	Time	Sampler Name	Equipment Model		Depth to Water (ft)		Depth to Bottom (ft)	
					uncorrected		uncorrected	
			corr. factor		corrected		corrected	

Measurement Point: ______________________________

Well Condition

General Condition	Visible Well ID	Well Cap Present	Well Plumbness	Lock

Concrete Collar	Ponded Water	Comments:

Well Purging Data

Date	Time						Sampler Initials	Instrument Calibration Date
	Equipment Set-up		Purging		Sample Collection			
	Start	Finish	Start	Finish	Start	Finish		

	Instrument Mfg & Model
pH	
Temp.	
Sp. Cond.	
ORP	
DO	
Turbidity	

Initial Water Depth (ft):				Time:				
Time	**Water Depth (ft)**	**Flow Rate (ml/min)**	**pH (s.u.)**	**Temp (^{o}C)**	**Sp Con (uS)**	**ORP (mV)**	**DO (mg/l)**	**Turbidity (ntu)**
Req. Limits for Last 3 Readings								

Pump Mfg & Model	Color	Odor	Purge Vol (ml)	Sample Depth (ft.)

Sample Containers

Type & No.	Volume	Preservative

Type & No.	Volume	Preservative

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Monitoring Well Data Sheet

Page ____ of ____

Well ID:

Site Background Information

Site Location: ____________
Job Number: ____________
Weather: ____________

Sampling Dates: ____________
Field Team Leader: ____________
Team Personnel: ____________

Time	Water Depth (ft)	Flow Rate (ml/min)	pH (s.u.)	Temp (^{o}C)	Sp. Cond. (uS)	ORP (mV)	DO (mg/l)	Turbidity (NTUs)
Req. Limits for Last 3 Readings								

Low-Flow Ground Water Sampling Work Scope Summary

Site Name / Location:
Job Number:
Sampling Objectives: ______________________________

Project Manager / Requested By:
Urgency of Project:

Pumps

Specify Wells

☐ Peristaltic ____________
☐ Bladder (1 3/4" for 2"pvc) ____________
☐ Bladder (3/4" for 1"pvc) ____________
☐ grundfos ____________
☐ Whale ____________
☐ Other-specify type: ____________

Tubing type / Dia.

☐ **FTS standard 1/4" OD polyethylene / silicone through pumphead**
☐ Polyethylene
☐ Tygon
☐ Silicone
☐ 1/4"
☐ 3/8"

☐ Dedicate tubing to well
☐ Remove tubing after sampling

Sample depths

☐ Mid - water column / mid - screen

☐ Specify well depths/sample collection depth
Well ID - DTW / DTB(ft.)-screen lengths/tubing depth

Stabilization / Geochemistry evaluation parameters

	Parameters and/or Stabilization Ranges if Different from those Listed	
☐ pH ($^+$/- 0.10)	☐	________
☐ Temp ^{0}C (3%)	☐	________
☐ Spec. Cond. (3%)	☐	________
☐ ORP ($^+$/- 10mv)	☐	________
☐ DO (10%)	☐	________
☐ Turbidity (10% > 1ntu)	☐	________

Equipment / Meters

	Specify applicable wells
☐ YSI - 600 XL with flow-cell (pH, Temp.,Spec. Cond., ORP, DO)	____________
☐ YSI - 600 XLM with flow-cell (same as above with memory storage)	____________
☐ YSI-6920 w/ flow-cell (pH, Temp., Spec. Cond., ORP, DO, Turbidity)	____________
☐ HF Scientific (Turbidity meter)	____________
☐ Product probe - check if product is expected	

*** Please provide drill logs (for new jobs / new wells)**

Additional information / other specifics:

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Field Screening

SOP #108

Revision Date: August 8, 2019

LIST OF REVISIONS

Date	Summary of Changes	Approval
	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

Technical Director/
HRP Quality Assurance Officer

Gail L. Batchelder
Gail L. Batchelder, Ph.D., P.G., L.E.P.

August 8, 2019
Date

Vice President/
Practice Leader - Environmental

Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

TABLE OF CONTENTS

1.0 INTRODUCTION

This SOP identifies the general procedures to be used for screening of soil and water samples during the performance of field activities. Field-screening procedures include use of tool, instrument, or technique that results in the collection of real-time or near real-time environmental data.

Equipment:	Equipment used for field screening varies by the type of screening to be performed. The types of equipment needed for each field screening technique are identified in the specific sections of this SOP associated with the individual types of field screening procedures.
Documentation:	Field notebook, map, and/or field work sheets, including geologic boring logs, to detail location of sampling points and relevant information related to sample collection and field screening measurements.

This SOP has been prepared to describe standard procedures that will be used in most cases during the performance of field screening activities. However, nothing in this standard operating procedure is intended to preclude the application of sound professional judgement during the performance of field activities. Should situations arise that require alternative procedures to those described herein in order to accomplish overall project objectives or to meet data quality objectives, field personnel should document the rationale for changes to the standard procedures in the field paperwork and describes the procedures that were followed instead. In some cases, the need for changes to standard protocols may be recognized ahead of time, in which case, the procedures to be followed should be described in project-specific work plans or work instructions.

Similarly, the procedures described herein are not intended to conflict with any specific federal, state, or local statutes, regulations, guidance, protocols, or specific instructions of a regulatory authority. If changes to the SOP are needed, such changes should be identified in project-specific work plans or other similar document that will be maintained in the project record.

2.0 FIELD SCREENING PHYSICAL METHODS

2.1 Visual Observations

Visual observations of samples being collected during environmental investigations can be an important tool in understanding the hydrogeology and/or geochemistry at and in the vicinity of the location where the sample was collected and provide useful information for development of the conceptual site model and selection of individual samples for subsequent laboratory analysis. Therefore, detailed descriptions of soil and water characteristics are considered to be an important component of field screening procedures.

For soil, observations should include such characteristics as color, texture and grain-size distribution, relative moisture content, and relative density. Characterization of soil samples should be recorded in the field on geologic boring logs for soil samples collected from soil borings. Descriptions of soil samples for other collection methods should be recorded on appropriate field paperwork designated for that purpose.

Visual observations should be in accordance with one or more standard protocols for visual identification of soil samples based on grain-size distribution and physical characteristics of the soil sample. Specifically, soil descriptions and classifications should be performed in accordance with ASTM Standard D2488-17, *Practice for Description and Identification of Soils (Visual-Manual Procedure)* and ASTM Standard D2487-17*, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System),* and/or HRP's SOP #103 *Soil Logging Using a Modified Burmister Classification System,* as appropriate based on the data quality objectives for the project and any regulatory requirements or guidance.

For water, the sampler should record such observations as color; turbidity; and amount, nature, and color of any suspended material as settling occurs. If a sheen or separate-phase non-aqueous-phase liquid (NAPL) is observed, that should be noted, and the nature of the observation with respect to color, general appearance, and density relative to the water sample (i.e., whether the separate-phase accumulates at the top of a container of the water or at the bottom), which would indicate whether the separate-phase liquid is light NAPL (LNAPL) or dense NAPL (DNAPL).

2.2 Olfactory Observation

Olfactory observations should be noted only if odors are evident in ambient air conditions. Under <u>no</u> circumstances are personnel allowed to directly smell samples from containers. Only if the nature of the odor is clearly recognizable as attributable to a certain type of chemical (such as petroleum product or chlorinated solvent, for example), is it permissible to record that aspect of the olfactory observation on the field boring log or in field notes.

3.0 NON-AQUEOUS-PHASE LIQUID (NAPL) DETERMINATION KITS (SOILS)

Where NAPL is suspected based upon historical site knowledge or elevated screening levels for volatile organic compounds, project-specific DQOs for data collection may include an evaluation of the presence NAPL in the field. Commercial NAPL detection/screening products will be used by HRP personnel. In all cases, manufacturer's instructions will be followed. Non-Sudan IV based dyes will be preferentially selected as a non-toxic, hydrophobic indicator of the presence NAPL. Sudan IV based dyes should not be selected unless specifically required by a state of federal agency, due to the recent determination that Sudan IV dye is a mutagen. The limitations of the specific products selected should be well understood prior to use, and it should be recognized that any product is more likely to yield a false-negative result than a false-positive result, so information gained during field screening for the presence of NAPL must be reviewed in conjunction with other data available for each sample and for the investigation area as a whole.

Personal protective equipment (PPE) should be donned and maintained in accordance with the site-specific work plan and/or health and safety plan during the sampling and screening procedures. In the event that no PPE has been specified for a particular sampling event, disposable latex gloves should be donned, at a minimum, during all sampling procedures. Gloves must be changed after each individual sample collection event.

Sampling/screening equipment will be largely determined by manufacturer's instructions. Commercial test kits may consist of pre-measured dye packets that are enclosed in clean sampling cups. Specified quantities of soils are emplaced in the sampling cups, taking care not to disturb the dye package. Clean tap water is then added to the container. The container is sealed and shaken vigorously. If NAPL is present at a concentration generally greater than 500 ppm, it will separate from the soils and change color. The color of the NAPL will be dependent on the test kit selected. The sampling kits and soils should be containerized and properly disposed.

4.0 FIELD INSTRUMENT SCREENING

4.1 Photoionization Detector (PID)

PIDs are used during the performance of field activities for general screening of soil, water, or air for the presence of volatile organic compounds (VOCs). The instrument is used only to screen for the presence of total concentrations of VOCs, not for the presence of individual constituents, and not all constituents of interest may be detected by the instrument.

PIDs can only monitor air quality, and no water/soil should be introduced into sample line. This method has limited use in high humidity or in the presence of methane or other compounds that have high ionization potentials. However, performance may be improved by using a vapor trap in PID models that may be equipped with one.

Users should refer to the operation manual for the instrument being used to ensure that electron voltage for the bulb used is appropriate for compounds to be detected. Halogenated alkanes, such as 1,1,1-trichloroethane, or higher molecular weight aromatic compounds traditionally use a higher electron volt bulbs (11.7 ev) due to the increased strength of bonding force of these chemicals. For general screening of matrices, use a 10.6 electron volt bulb as an "all purpose" bulb; but a predetermination of compounds to be detected is helpful before making this decision. Generally, straight-chain hydrocarbon carbons are not ionizable using a PID, and therefore, the presence of those compounds will not be detected by the instrument.

4.1.1 Specific Equipment List

- Photoionization detector
- Sealable plastic/polyethylene bags
- Personal protection equipment
- Calibration gas

4.1.2 Documentation

- Site plan
- Activity log/sample log
- Notebook – sketch pad

4.1.3 Procedure

Following calibration of instrument:

1. Record background reading.
2. Place a small quantity of matrix to be tested into a sealable plastic/polyethylene bag.
3. Let matrix warm to room temperature.
4. Insert probe tip into bag (<u>do not</u> insert probe into matrix).
5. Record reading.

Samples that are wet may give a false positive reading. This effect is present when readings gradually increase with no discernable leveling off. If this effect is observed, the instrument bulb should be cleaned, and the instrument recalibrated, prior to re-testing the sample. If the response persists, the screening results should be noted as suspect. However, to help minimize the effect of moisture on screening results, some PID models may be equipped with a moisture trap to remove at least some of the moisture as the air enters the instrument.

For air monitoring purposes one can either wear the monitor with straps or have monitor in the exclusion zone close and at the breathing zone level. Instrument readings will be recorded through time at intervals specified in the health and safety plan.

For water samples, place approximately 10 milliliters (ml) of water in a non-preserved glass 40 ml VOA vial. Shake vigorously and allow to settle. Open vial and tip cap slightly sideways to allow entrance of instrument probe. Do not insert probe into water, as the instrument pump will draw water into the sample line and to the bulb, which will ruin the instrument and bulb.

4.2 Gas Chromatograph

4.2.1 Specific Equipment List

- Portable gas chromatograph with a pre-column, backflush oven, and PID detector
- Ultra-zero air
- Water standards/blanks
- Syringes

4.2.2 Documentation

- Site plan
- Activity log
- Organic vapor headspace form
- Notebook – sketch pad

4.2.3 Procedure

A portable gas chromatograph with a pre-column, backflush oven, and PID/FID detector is used to analyze the "headspace gas" obtained from each soil sample. The peak amplitudes and retention times obtained from each sample are compared to standard peaks and retention times obtained from prepared in-house standards from a suite of volatile organic compounds expected, or likely, to be present in the media sampled. Based on a comparison of the sample results with the standards, the amounts and types of contaminants in each sample are determined.

The headspace screening is performed on-site in a mobile trailer laboratory, a support vehicle, or in a designated location in a site building. This is an initial semi-quantitative "headspace" screening only and is not a state-certified laboratory analysis performed using standard EPA methods.

"Ultra-zero air" certified to contain less than 0.1 parts per million (ppm) total hydrocarbons is used as the carrier gas. The gas chromatograph's oven runs isothermally at 40ºC. The total run time for each sample is sufficient to allow analysis of the targeted volatile organics. Both sample and standard injection volumes are recorded to allow direct quantification between standards and unknowns. The carrier gas flow rate is also held constant at approximately 10 cubic centimeters (cc)/minute to assure constant retention times.

During the screening, a Quality Assurance/Quality Control (QA/QC) program is followed. The purpose of the QA/QC program is to assure that any soil contamination detected in the soil samples did not arise from interferences and to provide semi-quantitative basis for sample evaluation.

The QA/QC program consists of a periodic injection of “headspace” gas obtained from water standards and analysis of “blanks”. Calibration standards of specific compounds and a range of concentrations for certain targeted volatile organic compounds will be obtained from a state-certified laboratory or prepared by HRP (determined on a site-specific basis). These standards are injected into the GC, and results for the targeted compounds are then stored in the GC’s “memory” prior to sample collection. Various “blank” analyses were performed to evaluate potential avenues of cross-contamination.

“Blank” analyses consist of:

1. Instrument blanks (no injection) to check the potential for column carry-over and “ultra-zero air” cleanliness;
2. Syringe blanks to check the potential for needle carry-over;
3. Soil sample container blanks to determine container cleanliness (although sample containers are pre-tested for contaminants under a QA/QC program which is completed by the manufacturer of the containers); and
4. Ambient “background” air blanks in both the sample collection and instrument areas to check the potential for cross-contamination from airborne contaminant sources.

All chromatograms are stored on a computer library and are later downloaded to a hard copy. Peak areas are integrated by the GC’s computer by comparison with standards pre-programmed into the library. Preparations containing selected potential site contaminants are generally injected into the GC to “check” retention times on a twice daily basis.

The objectives of the QA/QC program are achieved on the sampling dates when:

1. GC column carry-over is not found to be significantly interfering with any of the analyses;
2. Carry-over syringe contamination is not detected after any sample injection;
3. No interference due to volatile organic contamination is detected in any container blanks (e.g. 40 ml VOA septa soil sampling jar);
4. Ambient air in the sample analysis area and outside the building is not found to be significantly interfering with the soil sample screening results; and
5. The “ultra-zero air” used in the gas chromatograph has no contaminants present before testing.

4.3 Specific Conductance, pH, Dissolved Oxygen, Oxidation/reduction Potential

Screening-level measurements of the standard water-quality parameters of specific conductance, pH, dissolved oxygen (DO), and oxidation/reduction potential (ORP), may be made using stand-alone instruments specific to the parameter being measured, or by combination instruments that measure one or more of the parameters at the same time. The most common type of combination measurement technique currently used is a flow-through cell that is used in conjunction with low-flow groundwater sampling techniques. When using a flow-through cell, measurements are made using specific electrodes within a closed cell as groundwater is pumped from a well at a low flow rate moves through the cell. In contrast, most stand-alone meters require that separate aliquots of water be collected into a container that is exposed to the atmosphere as the electrodes equilibrate in the solution and measurements are recorded.

Although the equipment varies depending on the instrument(s) used, documentation is the same for all types or combinations of instruments. Documentation needs include the following:

- Activity Report
- Notebook
- Monitor Well Data Sheet or field sampling log (for water samples other than groundwater).

In all cases, instruments should be used, calibrated, and maintained in accordance with manufacturer’s instructions. Information provided in the following sub-sections is provided as an overview of information related to measurement of specific parameters. Additional, more detailed information can found in the operating manuals for the specific equipment and in the references provided in Section 7.0 of this SOP.

4.3.1 Specific Conductance

Conductivity/salinity meters are used to determine the electrical conductance and salinity of water/wastewater. Values are generally expressed in µmhos/cm or µS/cm (µSiemens/cm).

4.3.1.1. Specific Equipment List

- Instrumentation for measurement of specific conductance (e.g., conductivity/salinity meter, hand-held conductivity meter)
- Calibration solution

4.3.1.2. Procedure

Calibration of the instrument must be performed prior to measurement of specific conductance for individual samples. All calibration procedures and measurements of specific conductance for samples will be conducted in accordance with manufacturer’s instructions for the specific instrument being used. Specific conductance readings are affected by temperature, so it is important that the instrument settings are adjusted to take the temperature into account or to ensure that the specific conductance meter uses an automatic temperature compensator.

4.3.2 pH

The pH meter is used for determining the acidity of water and wastewater as expressed in pH units.

4.3.2.1. Specific Equipment List

- Instrumentation used to measure pH (may be a combination meter that measures other parameters or may be a stand-alone, hand-held pH meter).
- Standard pH calibration solutions (pH 4.0, pH 7.0, pH 10.)

4.3.2.2. Procedure

Following calibration procedures, immerse end of probe into liquid sample (an aliquot of sample not used for laboratory analysis). Allow probe to acclimate to sample. Meter will provide digital read-out of pH in standard pH units.

4.3.3 Dissolved Oxygen Meter

The dissolved oxygen (DO) meter is used for determining the dissolved oxygen content in milligrams per liter.

4.3.3.1. Specific Equipment List

- DO Meter
- Potassium chloride (KCl) solution
- Probe membranes

4.3.3.2. Procedure

Following calibration procedures, immerse end of probe into liquid sample (aliquot of sample not used for laboratory analysis). Allow probe to acclimate to sample. Meter will provide a digital read-out in mg/l or %. The probe should be slowly raised and lowered while remaining completely submersed in the sample in order to obtain an accurate reading.

4.3.4 Oxidation/reduction Potential

An oxidation/reduction potential measurement indicates the difference in electric potential between an indicator electrode and an appropriate reference electrode. Oxidation/reduction potential is a useful indicator of the equilibrium oxidation state of a chemical species in the water sample being tested, particularly when evaluated in conjunction with the pH of the solution. ORP is reported in millivolts (mV).

4.3.4.1. Specific Equipment List

- Instrumentation for measurement of ORP (meter, indicator electrode, reference electrode)
- Calibration solution (Zobell solution)

4.3.4.2. Procedure

ORP is temperature dependent, so the meter should have automatic temperature compensation and the probe must be allowed to equilibrate to the ambient temperature of the solution before the measurement is recorded (calibration solution must be at ambient temperature), or a separate temperature measurement must be made and the value measured by the instrument must be corrected based on the recorded temperature of the solution.

In some cases, the instruction manual will indicate that the instrument is calibrated at the factory. If so, the Zobell solution should be used to verify the factory calibration. If the two measurements do not agree, the first step is to use a new Zobell solution. If the measured value still does not agree with the value for the Zobell calibration solution, the instrument will need to be recalibrated by the manufacturer.

4.4 Turbidity

Instruments that measure turbidity measure the difference between the intensity of light scattered by a liquid sample, generally water, compared to the intensity of light scattered by a standard reference suspension. Turbidity measurements indicate the amount of suspended or colloidal material in a water sample, and results may be affected by the color of the water sample. A turbidity meter (turbidimeter) provides results in nephelometric turbidity units (NTUs).

4.4.1 Specific Equipment List

- Turbidimeter
- Calibration solution (for example, a commercially available polymer primary standards (AMCO-AEPA-1)

4.4.2 Procedure

The calibration standard (or standards if the instrument uses more than one standard) should be allowed to equilibrate to the ambient temperature. Initially, a standard with a low turbidity value (0.0 or 0.02 NTU) should be used to calibrate the instrument in accordance with the manufacturer’s instructions. A 0 NTU standard solution can be prepared by filtering distilled water through a 0.45-micron filter. The instrument should read the standard value to within the specifications of the instrument. If the instrument accepts more than one standard, at least one additional standard at a relatively high turbidity value should be used. If the instrument accepts only one standard, the higher standard should be used as a check standard for the instrument to ensure that the instrument identifies the value of the check standard within the specifications of the instrument.

An important consideration when using a turbidimeter is ensuring that the cuvettes in which the water samples and calibration solution are placed for measurement are free from scratches and that the outside surface are dry and the clarity is not affected by such things as fingerprints or dust. If the cuvette cannot be cleaned, it should be discarded. Therefore, it is important to have a number of cuvettes available for each sampling event.

5.0 EQUIPMENT CALIBRATION METHODS

All field equipment will be calibrated immediately prior to use in the field. The calibration procedures will follow standard manufacturer's instructions or routine HRP procedures to assure that the equipment is functioning within tolerances established by the manufacturer and required by the project. Field personnel will document all instrument calibrations in bound field notebooks and on specific calibration forms. All records generated will be maintained by field personnel and are subject to audit by the Task or Project Manager.

The detailed calibration, operation, and maintenance procedures for field instrumentation routinely used by HRP personnel are specific to manufacturer's instructions. The following sections will briefly summarize these procedures.

Calibration standards and pH buffer solutions used for field instrumentation calibration checks will be obtained from scientific products supply companies (e.g., Fisher Scientific; American Scientific Products, etc.). All buffer and calibration standards obtained will be certified and standardized against or traceable to a reliable primary reference standard. All solutions are stored according to manufacturer's suggestion for optimal shelf-life. Chemical container labels must also include the date received, date opened, as well as the initials of the analyst who first opened the container. Stock solutions will be marked with expiration date and replaced with new solutions when the recommended shelf-life is exceeded.

5.1 Photoionization Detector (PID)

HRP uses several types of PIDs made by different manufacturers. Calibration procedures which are specific to each instrument can be found in the manufacturer's operation manual. The PIDs will be calibrated in the field, under the working temperature conditions where it is to be used. The calibration gas typically used is isobutylene at a concentration of 100 ppm. Calibrations should be recorded in the field notebook and on the calibration log of the Health and Safety Plan. Calibration records should note the date, instrument manufacturer and model, calibration gas and concentration, and operator.

5.2 Temperature/Conductance Meter

Calibration is performed at the start of each sampling day using potassium chloride (KCl) standard solutions. Calibrations are recorded in either a bound field notebook or on field calibration forms. Specific conductance standards are selected to bracket the range of values expected in the samples. If the unit has a calibration adjustment, the meter is calibrated in the same manner as the pH meter. Internal automatic adjustments are made on meters which lack a designated calibration knob. The meter must read within 10 percent of the standard to be considered in control and acceptable.

If the calibration indicates the meter is out of calibration, a backup unit should be employed. Readings from conductivity meters lacking calibration adjustments are limited to checks at the beginning and end of the sampling day. All calibrations may be recorded in a bound field notebook along with conclusions as to the acceptability of readings.

Temperature is measured using a glass thermometer. Field thermometers must be periodically checked against a National Institute of Standards Technology (NIST) thermometer. Acceptance criteria are ±1°C. Any thermometers exceeding these limits should not be used to record temperature readings. The calibration frequencies noted above are the minimum requirements. Additional checks should be performed if the unit experiences harsh conditions or if readings become erratic.

5.3 pH Meter

Calibration is performed at the start of each sampling day using at least two standard calibration solutions which bracket the pH range expected in the samples. Standard calibration solutions are available as pH 4, pH 7, and pH 10. Calibration is recorded in either a bound field notebook or on field calibration forms. Calibration knobs are used to set the meter to read the value of the standard. The meter is then checked during the sampling period, using at least one standard, at a frequency which results in little or no calibration adjustment. If the reading varies by more than one-tenth of a unit between calibration checks, the frequency of the checks must be increased. Temperature and pH must be taken on an aliquot of the sample that is not used for laboratory analysis.

5.4 Dissolved Oxygen Meter

Calibration is performed at the start of each sampling day following instructions in the operation manual. The DO probe uses potassium chloride (KCl) solution contained within a membrane. This membrane and solution should be changed as part of daily calibration procedures. If a bubble is present behind the membrane, if the solution is not present, or if the solution has not been recently changed, accurate DO readings will not be obtained, and the membrane and solution will require replacement. For calibration, place the probe in its storage/calibration chamber within the instrument housing. Using the calibration mode, the instrument is self-calibrating. Calibrations should be recorded in a field notebook or on field calibration forms.

5.5 Equipment Deficiency/Operational Status Reporting

All calibrations will be recorded in a field notebook. These calibration records become part of the individual project files as documentation of the attainment of QA objectives.

6.0 PREVENTATIVE MAINTENANCE

6.1 Routine Maintenance

HRP personnel routinely maintain field equipment for optimal results. All maintenance procedures are documented in control logbooks designated for each piece of equipment. Any field activities involving routine maintenance will be recorded in field logbooks by the individual performing the adjustment of the equipment. Maintenance performed at an authorized repair service will be documented in the maintenance log, including service location, specific repair, and method of transport. Methods of routine maintenance depend on the instrument and manufacturer. The manufacturers' operations manuals will be the primary source of information for these procedures.

6.2 Documentation

Field Services Managers maintain all documentation concerning routine maintenance and non-routine repairs. All pertinent information regarding instrument status is recorded in personnel field log books along with calibration documentation.

6.3 Contingency

In the event that the primary field equipment is inoperable as determined by calibration difficulties, back-up field instruments will be obtained from other sources. These instruments will be calibrated prior to recording data. In no event shall instruments be used to record data unless the performance of the equipment has been documented.

7.0 REFERENCES FOR FIELD SCREENING METHODS

New York State Department of Environmental Conservation (NYSDEC). 2010. "DER-10, Technical Guidance for Site Investigation and Remediation", Division of Environmental Remediation. May 2010.

NYSDEC. Technical Procedural Guidance, Equipment Training, Calibration, and Maintenance, “Spill Guidance Manual” Section 2.2.

USEPA. 2017. “Standard Operating Procedure Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity)”, USEPA, Region 1, Quality Assurance Unit, Revision Number 3, Revised March 23, 2017.

APPENDIX B

FIELD FORMS

HRP Associates, Inc. 1
Fairchild Square, Suite 110
Clifton Park, NY 12065
(518) 877-7101

GROUNDWATER MONITORING WELL PURGING/WELL DEVELOPMENT FORM

DEPARTMENT OF ENVIRONMENTAL CONSERVATION • NEW YORK STATE •

Project:	WAS #:	Field Personnel:
Location:	Well ID.:	Weather:
Sounding Method:	Gauge Date:	Measurement Ref:
Stick Up/Down (ft):	Gauge Time:	Well Diameter (in):

Purge Date:	Purge Time:
Purge Method:	Field Technician:

1) Well Depth (ft):	4) Well Diameter (in):	7) Five Well Volumes (gal):
2) Depth to Water (ft):	5) Well Volume / Foot (gal) (d^2x.0408):	Depth/Height of Top of PVC:
3) Height of H_2O Column (1-2) (ft):	6) Total Well Volume (gal) (3x5):	Pump Type:

Water Quality Parameters

Time (hrs)	DTW (ft btoc)	Volume (liters)	Rate (mL/m)	pH (pH units)	ORP (mV)	remperatur (oC)	Gonductivit: (uS/cm)	DO (ug/L)	Turbidity (ntu)

Total Quantity of Water Removed (gal):		Sampling Time:	
Samplers:		Split Sample With:	
Sampling Date:		Sample Type:	

COMMENTS AND OBSERVATIONS:	

HRP ASSOCIATES, INC.

PAGE ______ OF ______

SAMPLE DATE: ____________________

LOW-FLOW SAMPLING LOG

TOTAL # WELLS: ____________________

Client Name: ______________________________ Sample Pump: ______________________

Project Location: ______________________________ Tubing Type: ______________________

Sampler(s): Monitoring Equipment: ______________________

Well I.D. ______________________________ Screened Interval (fbg): ________ to ________

Well Diameter (inches): ______________________________ Tubing Intake Depth (fbg): ______________________

Total Depth (fbg): ______________________________ Comments: ______________________

Depth to Water (feet from TOC): ______________________________ ______________________

Well Condition:

Time	Depth to Water (from TOC)	Evacuation Rate	Water Quality Monitoring Parameters					
			Temperature	pH	ORP	Conductivity	Turbidity	Dissolved oxygen
(hours)	(feet)	(ml/min)	(^{o}C)		(mv)	(ms/cm)	(NTU)	(mg/l)

Stabilization of Parameters (stabilization achieved for three consecutive measurements)

Time		Depth to Water	Evacuation Rate	Temperature	pH	ORP	Conductivity	Turbidity	Dissolved oxygen
FROM	TO	(ft btoc)	(ml/min)	(oC)		(mv)	(ms/cm)	(NTU)	(mg/l)
Recommended Stabilization		+/- 0.3	100-500	+/- 3%	+/- 0.1	+/- 10	+/- 3%	+/- 10%	+/- 10%
Stabilization: (Yes/No)									

Sample Time: ______________________________ Reviewed by: ______________________________

ft btoc	feet below top of casing	NTU	Nephelometric Turbidity Units	°C	degrees Celsius
ml/min	milliliters per minute	mg/l	milligrams per liter	mv	millivolts
µs/cm	microseimons per centimeter				

	HRP Associates, Inc. **Monitoring Well Installation Log**	**WELL NO:**
		PAGE 1 **OF** **PAGES**

PROJECT:	**SCREEN SIZE & TYPE:**
JOB NUMBER:	**SLOT NO.:** **SETTING:**
DATE COMPLETED:	**SAND PACK SIZE & TYPE:**
DRILLING COMPANY:	**SETTING:**
RIG TYPE:	**CASING SIZE & TYPE:**
DRILLING METHOD:	**SETTING:**
HAMMER WEIGHT/DROP:	**SEAL TYPE:**
SAMPLING METHOD:	**SETTING:**
OBSERVER:	**BACKFILL TYPE:**
REFERENCE POINT (RP):	**STATIC WATER LEVEL:**
STICK-UP:	**GPS COORDINATES: N:**
SURFACE COMPLETION:	**W:**

REMARKS:

ABBREVIATIONS: SS = split spoon W = wash C = cuttings G = grab ST = shelby tube REC = recovery PPM = parts per million

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	REC. (FEET)	MOISTURE	DESCRIPTION	PID READING (PPM)
FROM	TO						

PROJECT: **JOB NUMBER:**

WELL NO.: **PAGE OF**

DEPTH (FEET)		SAMPLE TYPE	BLOW COUNT	REC. (FEET)	MOISTURE	DESCRIPTION	PID READING (PPM)
FROM	TO						

HRP Associates, Inc.

Soil Boring Log for Direct-push Drilling

Project:	**Boring I.D.:**
Job Number:	**Date:**
Drilling Company:	**Time:**

Location:

GPS Coordinates N: W:

Sample Interval (fbg)		Sample ID	Recovery (feet)	Description (grain size, color, relative density, moisture, staining, odor)	PID (ppm)
Top	Bottom				

Well Screen:		**Soil Samples Collected:**	**Time**
Water Sample ID	Time		
Sampling Method:			
Description of Water:			

HRP Associates, Inc.
1 Fairchild Square, Suite 110
Clifton Park, NY 12065
(518) 877-7101

FIELD SOIL VAPOR SAMPLING FORM

DEPARTMENT OF ENVIRONMENTAL CONSERVATION • NEW YORK STATE •

Project:		Building I.D.	
WAS #:		Vapor I.D. #:	
Date:		Sampler:	
Location:		PID Meter used:	

SUMMA Canister Record:

SOIL VAPOR POINT		DUPLICATE SAMPLE (IF COLLECTED)	
Flow Regulator No.:		Flow Regulator No.:	
Canister Serial No.:		Canister Serial No.:	
Start Date/Time:		Start Date/Time:	
Start Pressure: (inches Hg)		Start Pressure: (inches Hg)	
Stop Date/Time:		Stop Date/Time:	
Stop Pressure: (inches Hg)		Stop Pressure: (inches Hg)	
Sample ID:		Sample ID:	

Other Sampling Information:

Helium percentage achieved in enclosure for Tracer Gas Test		Depth to sample point	
Tracer Gas test result (% of Helium):		Nearest Groundwater Elevation:	
Noticeable Odor?			
Purge Volume PID Reading (ppb)			
Duplicate Sample?			
Outdoor Ambient Temperature:			
Wind Direction:		Additional Info:	

Comments:

HRP Engineering, P.C.
1 Fairchild Square, Suite 110
Clifton Park, NY 12065
(518) 877-7101

FIELD SOIL VAPOR SAMPLING FORM

Project:		Building I.D.	
WAS #:		Vapor I.D. #:	
Date:		Sampler:	
Location:		PID Meter used:	

SUMMA Canister Record:

SOIL VAPOR POINT		DUPLICATE SAMPLE (IF COLLECTED)	
Flow Regulator No.:		Flow Regulator No.:	
Canister Serial No.:		Canister Serial No.:	
Start Date/Time:		Start Date/Time:	
Start Pressure: (inches Hg)		Start Pressure: (inches Hg)	
Stop Date/Time:		Stop Date/Time:	
Stop Pressure: (inches Hg)		Stop Pressure: (inches Hg)	
Sample ID:		Sample ID:	

Other Sampling Information:

Helium percentage achieved in enclosure for Tracer Gas Test		Depth to sample point	
Tracer Gas test result (% of Helium):		Nearest Groundwater Elevation:	
Noticeable Odor?			
Purge Volume PID Reading (ppb)			
Duplicate Sample?			
Outdoor Ambient Temperature:			
Wind Direction:		Additional Info: Heavy rain throughout the day	

Comments:

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(518) 877-7101

FIELD SOIL VAPOR SAMPLING FORM

DEPARTMENT OF ENVIRONMENTAL CONSERVATION • NEW YORK STATE •

Project:		Building I.D.	
WAS #:		Vapor I.D. #:	
Date:		Sampler:	
Location:		PID Meter used:	

SUMMA Canister Record:

SOIL VAPOR POINT		DUPLICATE SAMPLE (IF COLLECTED)	
Flow Regulator No.:		Flow Regulator No.:	
Canister Serial No.:		Canister Serial No.:	
Start Date/Time:		Start Date/Time:	
Start Pressure: (inches Hg)		Start Pressure: (inches Hg)	
Stop Date/Time:		Stop Date/Time:	
Stop Pressure: (inches Hg)		Stop Pressure: (inches Hg)	
Sample ID:		Sample ID:	

Other Sampling Information:

Helium percentage achieved in enclosure for Tracer Gas Test		Depth to sample point	
Tracer Gas test result (% of Helium):		Nearest Groundwater Elevation:	
Noticeable Odor?			
Purge Volume PID Reading (ppb)			
Duplicate Sample?			
Outdoor Ambient Temperature:			
Wind Direction:		Additional Info: Heavy rain throughout the day	

Comments:

HRP Associates, Inc. 1 Fairchild Square, Suite 110 Clifton Park, NY 12065 (518) 877-7101	FIELD SOIL VAPOR SAMPLING FORM	

Project:		Building I.D.	
WAS #:		Vapor I.D. #:	
Date:		Sampler:	
Location:		PID Meter used:	

SUMMA Canister Record:

SOIL VAPOR POINT		DUPLICATE SAMPLE (IF COLLECTED)	
Flow Regulator No.:		Flow Regulator No.:	
Canister Serial No.:		Canister Serial No.:	
Start Date/Time:		Start Date/Time:	
Start Pressure: (inches Hg)		Start Pressure: (inches Hg)	
Stop Date/Time:		Stop Date/Time:	
Stop Pressure: (inches Hg)		Stop Pressure: (inches Hg)	
Sample ID:		Sample ID:	

Other Sampling Information:

Helium percentage achieved in enclosure for Tracer Gas Test		Depth to sample point	
Tracer Gas test result (% of Helium):		Nearest Groundwater Elevation:	
Noticeable Odor?			
Purge Volume PID Reading (ppb)			
Duplicate Sample?			
Outdoor Ambient Temperature:			
Wind Direction:		Additional Info:	

Comments:

HRP Engineering, P.C. 1 Fairchild Square, Suite 110 Clifton Park, NY 12065 (518) 877-7101	FIELD SOIL VAPOR SAMPLING FORM	DEPARTMENT OF ENVIRONMENTAL CONSERVATION • NEW YORK STATE •

Project:		Building I.D.	
WAS #:		Vapor I.D. #:	
Date:		Sampler:	
Location:		PID Meter used:	

SUMMA Canister Record:

SOIL VAPOR POINT		DUPLICATE SAMPLE (IF COLLECTED)	
Flow Regulator No.:		Flow Regulator No.:	
Canister Serial No.:		Canister Serial No.:	
Start Date/Time:		Start Date/Time:	
Start Pressure: (inches Hg)		Start Pressure: (inches Hg)	
Stop Date/Time:		Stop Date/Time:	
Stop Pressure: (inches Hg)		Stop Pressure: (inches Hg)	
Sample ID:		Sample ID:	

Other Sampling Information:

Helium percentage achieved in enclosure for Tracer Gas Test		Depth to sample point	
Tracer Gas test result (% of Helium):		Nearest Groundwater Elevation:	
Noticeable Odor?			
Purge Volume PID Reading (ppb)			
Duplicate Sample?			
Outdoor Ambient Temperature:			
Wind Direction:		Additional Info: Heavy rain throughout the day	

Comments:

HRP Engineering, P.C.
1 Fairchild Square, Suite 110
Clifton Park, NY 12065
(518) 877-7101

FIELD SOIL VAPOR SAMPLING FORM

DEPARTMENT OF ENVIRONMENTAL CONSERVATION • NEW YORK STATE •

Project:		Building I.D.	
WAS #:		Vapor I.D. #:	
Date:		Sampler:	
Location:		PID Meter used:	

SUMMA Canister Record:

SOIL VAPOR POINT		DUPLICATE SAMPLE (IF COLLECTED)	
Flow Regulator No.:		Flow Regulator No.:	
Canister Serial No.:		Canister Serial No.:	
Start Date/Time:		Start Date/Time:	
Start Pressure: (inches Hg)		Start Pressure: (inches Hg)	
Stop Date/Time:		Stop Date/Time:	
Stop Pressure: (inches Hg)		Stop Pressure: (inches Hg)	
Sample ID:		Sample ID:	

Other Sampling Information:

Helium percentage achieved in enclosure for Tracer Gas Test		Depth to sample point	
Tracer Gas test result (% of Helium):		Nearest Groundwater Elevation:	
Noticeable Odor?			
Purge Volume PID Reading (ppb)			
Duplicate Sample?			
Outdoor Ambient Temperature:			
Wind Direction:		Additional Info: Heavy rain throughout the day	

Comments:

HRP Associates, Inc.	**Test Pit Log**

Project:		**Test Pit I.D.:**
Job Number:		**Sketch Map:** (include approx..north arrow)
Date:	**Time:**	
Contractor:		
Location;		
Final Dimensions (L x W x D in feet):		
GPS Coordinates **N :** **W:**		

Sample Depth or Interval (fbg)		**Sample I.D.**	**Time**	**Location**	**Description (grain size, color, staining, odor, moisture)**	**PID (ppm)**
Upper	**Lower**					

Comments:

APPENDIX B

Site-specific Health and Safety Plan

MOVE YOUR ENVIRONMENT FORWARD

SITE-SPECIFIC HEALTH AND SAFETY PLAN (HASP)

Former Rickett's Dry Cleaner Site
2017-2019 Doubleday Avenue
Ballston Spa, New York
DEC Site ID # 546058

Prepared For:

New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233
Contract #D009808

Prepared By:

HRP Associates, Inc.
1 Fairchild Square, Suite 110
Clifton Park, NY 12065

HRP #: DEC1002.P3

Issued On: May 12, 2020

Addendum Number	Date Issued	Reason For Modification

Disclaimer

HRP Associates does not guarantee the health or safety of any person entering this site. Due to the potential hazards of this site and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards which may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury at this site. The health and safety guidelines in this plan were prepared specifically for this site for use and should not be used on any other site.

CERTIFICATION

This Addendum to HRP’s Generic Health and Safety Plan has been prepared under the supervision of, and has been reviewed by, a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals.

Mark Wright

Mark Wright, CSP
BCSP # 9086

TABLE OF CONTENTS

Figures

Tables

Appendices

1.0 EMERGENCY CONTACTS/PLANNING

The Health and Safety Officer will coordinate the entry and exit of response personnel in the event of an emergency. The following information, including directions to the nearest hospital shall be posted at the Site. When contacting the local authorities, be sure to provide: your name, facility name, full address, telephone number, and the nature of the emergency.

Emergency Phone Numbers
2017-2019 Doubleday Avenue
Ballston Spa, Milton, NY

Emergency Contact	Phone Number
Fire, Ambulance, Police Emergency:	911
Ballston Spa Police Department (routine calls):	518-885-5033
Ballston Spa Fire Department (routine calls):	518-885-5222
Saratoga Hospital (Saratoga Springs):	518-587-3222
Poison Control Center:	1-800-222-1222
DEC spills hotline:	1-800-457-7362
National Response Center:	800-424-8802
Project Manager: Mark Wright	203-308-0983
Site Safety Officer: Stefan Truex	518-867-9282
NYSDEC Project Manager: Nicole Hinze	518-728-0566

Map and directions to the following medical facilities are provided in **Figure 3**:

- **Saratoga Hospital -** located at 211 Church Street, Saratoga Springs, NY (approximately 6.5 miles from the work site)

First Aid, Fire Protection, Emergency Response Equipment Storage Locations

First Aid Kit:	In Vehicle
Fire Extinguisher:	In Vehicle
Eye Wash (Bottle):	In Vehicle

A Safety and Logistics Planning call will be held prior to conducting any intrusive activities at the site. Representatives from HRP and each subcontractor will attend the call to discuss logistical and safety challenges general to the scope of work and specific to the Site. This call is documented on the Safety and Logistics Planning Call Log in **Appendix A.**

2.0 INTRODUCTION

2.1 Purpose and Scope

This Health and Safety Plan (HASP) addresses the health and safety practices that will be employed by HRP Associates, Inc. personnel and our subcontractors participating in the REMEDIAL INVESTIGATION (RI) that will be performed at the site. The RI will be comprised of several tasks to evaluate the environmental condition of the Site and the surrounding area, including installation of test pits, soil borings and monitoring wells to collect soil and groundwater samples.

This HASP has been developed in accordance with HRP's Generic Safety and Health Program as required under OSHA's Hazardous Waste Operations Standard (29 CFR 1910.120). This Plan has been developed to establish minimum standards necessary for onsite investigation activities to protect the health and safety of HRP personnel. HRP site personnel have received the required level of training and field experience as required under subpart (e) of the Standard, and have received medical examinations in accordance with HRP's medical surveillance program as required under subpart (f) of the Standard. No other personnel will be permitted in the Exclusion Zone unless they have received training and medical surveillance under the Standard.

HRP personnel and associated contractors shall be familiar with this HASP prior to conducting proposed site work. This plan must be present on site and be available for reference/inspection when the subject site work is being conducted.

2.2 Site Information and Areas of Environmental Concern

2.2.1 Site Information and Description

Site Name:	Former Rickett's Dry Cleaner site
Site Address:	2017-2019 Doubleday Avenue, Ballston Spa, Milton, NY
Site Contact:	Nicole Hinze
Phone Number:	518-897-0566

2.3 Background and Project Description

The Rickett's Dry Cleaner Site, located at 2017-2019 Doubleday Avenue, Ballston Spa, Milton, New York, (**Figure 1**) is the focus of this investigation. This property is approximately 1.3 acres in size, according to the Saratoga County online GIS map viewer. Two buildings are currently present on the Site, an approximately 22,024 square foot former dry-cleaning and laundromat building originally constructed in 1930 and an approximately 2,250 square foot car wash building constructed in 1983. Site operations closed in 2013 and the property is not occupied at present. The site is connected to the municipal water supply and serviced by the municipal sanitary sewer. Surrounding land in the area of the Site is mostly residential properties.

Topography slopes generally to the south-southeast, towards Kayaderosseras Creek, which is located approximately ¼ mile (1,300 ft) southeast of the Site.

Environmental investigations were performed at the Site from 2008-2018, which identified a historical release of tetrachloroethylene (PCE), trichloroethylene (TCE) and associated chlorinated compounds that have impacted the soil vapor and groundwater at the Site. Data from these investigations indicated that these substances are present at elevated levels in downgradient monitoring wells located across Doubleday Ave from the Site. The proposed site characterization to be performed in conjunction with this HASP will work to define the degree and extent of the groundwater plume, as well as characterize the soils across the Site, including in the area of the former car wash.

2.3.1 Personnel Designations

The following personnel are designated to perform the stated project activities and to ensure that the requirements of this HASP are met. The same person may fill more than one role, and/or serve as an alternate in the absence of the designated team member.

The following personnel are designated to perform the stated project activities and to ensure that the requirements of this HASP are met. The same person may fill more than one role, and/or serve as an alternate in the absence of the designated team member. All subcontractors must have received the required level of training and field experience as required under subpart (e) of OSHA 29 CFR 1910.120 and OSHA 29 CFR 1926.65 for Hazardous Waste Operations and Emergency Response (HAZWOPER).

Project Team Member	Responsibilities and Tasks
Stefan Truex (or Qualified Alternate Safety Officer)	HSO – HRP Associates, Inc. - Ensuring all site work is being performed in accordance with HRP Associates, Inc. Safety Program, as well as in accordance with local, state and federal regulations. - Directing and implementing HRP's HASP. - Reviewing the Subcontractor's HASP and being aware of the hazards detailed therein. - Conduct a job orientation meeting and routine safety meetings for HRP Associates, Inc. employees and subcontractors, as applicable. - Provide copies of these inspections, recordkeeping/personnel logs to the engineer/contractor as required. - Ensuring all project personnel have been adequately trained in the recognition and avoidance of unsafe conditions. - Authorizing Stop Work Orders that shall be executed upon the determination of an imminent health and safety concern, and will notify the appropriate contacts upon issuance of this order. - Authorizing work to resume, upon approval from the Contractor. - Directing activities, as defined in the HRP's and the Contractor's written HASP, during emergency situations. - Providing personnel monitoring where applicable. - Ensuring that adequate personal protective equipment and first aid supplies are available. - Ensure site security, to the extent practicable. - Ensure accident victims are promptly cared for, and the incident is investigated and properly reported.
Mark Wright (Site Supervisor / Project Manager) **Jessica Kruczek (Alternate Site Supervisor)**	Site Supervisor/Project Manager – HRP Associates, Inc. - Monitor and assist the site Health and Safety officer. - Maintain appropriate rules, regulations and codes at the job site. - Provide advance safety planning for all activities through the use of scheduling and administrative controls. - Obtain site-specific health and safety information and communicate that information with the appropriate personnel (i.e. contractors, client, etc.) - Report all injuries, illnesses and other incidents to the Director of Safety. - Ensure all HRP personnel are trained and qualified to perform site work.
Site Workers (Subcontractors)	**Site Workers** - Read and work in accordance with this HASP. - Report all unsafe work practices to the HSO. - Report all incidents, including near-misses to the HSO. - Work in a safe manner. - Provide Designated Competent Person
A complete list of HRP employee and subcontractor responsibilities (as applicable) can be found in the HRP Generic Health and Safety Plan. 1 A list of site workers will be maintained in the Personnel Log (**Appendix B**) 2 Supervisors Investigation Report included as (**Appendix C**)	

3.0 AREAS OF ENVIRONMENTAL CONCERN

3.1 Scope of Work

In general, the work to be performed by HRP and HRP's subcontractors consists of investigative methods to evaluate the environmental condition of the Site. The RI investigation fieldwork for this task includes the following subtasks:

- Obtain site access to the Site with Site owners, and adjacent property owners. May require access agreements between DEC and property owner to be obtained;
- Call in Underground Utility Clearance through NYS Code Rule 753/Dig Safe System;
- Complete a Ground Penetrating Radar (GPR) survey to locate utilities and/or obstructions in the ground that may affect the locations of test trenches and/or monitoring wells;

<u>Test Pits</u>

- Four shallow test pits will be tested at exterior locations in the vicinity of potential release areas;
- One soil sample will be collected from each test pit;
- All samples will be submitted to the Department's requested laboratory Test America, Inc., a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified laboratory;
- As no complete series of investigatory analyses have been performed to date, one sample from each boring will be analyzed by Test America for Target Compound List (TCL) volatile organic compounds (VOCs)+10 by Method 8260, and TCL semi-volatile organic compounds (SVOCs) +20 by Method 8270. In addition, up to ten of these samples will be analyzed for Target Analyte List (TAL) metals, total cyanide, total mercury, TCL polychlorinated biphenyls (PCBs) via Method 8082, TCL chlorinated herbicides via Method 8151A, pesticides via Method 8081B, PFAS Analyte list compounds via methods based on EPA Method 537.1, and 1,4 dioxane via EPA Method 8270 SIM;

<u>Soils</u>

- Perform continuous split-spoon sampling at five overburden and five bedrock well locations and agreed-upon with the Department;
- Up to three soil sample samples from each boring will be collected, biased for collection as supported by the conceptual side model (CSM) for the pertinent release interval (i.e., surface or at a discharge invert elevation), or based upon field observation (staining, field instrument response, or groundwater table interface).
- As no complete series of investigatory analyses have been performed to date, one sample from each boring will be analyzed by Test America for TCL VOCs +10, TCL SVOCs +20. In addition, up to ten of these samples will be analyzed for TAL metals, total cyanide, total mercury, TCL PCBs, TCL chlorinated herbicides, pesticides, PFAS Analyte list compounds, and 1,4 dioxane;
- Remaining samples collected will be held pending analysis as a contingency; and

- All analytical samples will be completed using QA/QC NYSDEC Method Category B. The laboratory will submit analytical results to HRP in NYSDEC EDD format.

Groundwater

- Installation of five overburden wells to an estimated depth of 20 feet below ground surface (bgs), or to bedrock refusal. The wells will be constructed of 2-inch PVC with PVC slotted screens, and will be screened across the water table with an appropriate sized sand pack. The wells will be installed using flush-mounted protective casings and locking covers;
- Installation of five bedrock wells to an approximate depth of 35 feet bgs. Based on previous work performed at the Site, it is estimated that the bedrock interface is present at approximately 20 feet bgs and each well will be installed 10 feet into bedrock. Bedrock wells will be open hole and will have 4-inch steel casing socketed into the bedrock to form a seal and grouted in place to ground surface;
- The bedrock wells will be paired with new and existing overburden wells to support correlation for vertical delineation;
- Monitoring wells will be developed a minimum of 24 hours after their completion. Each well will be developed by pumping and surging for 2 hours, or until the field parameters stabilize for a minimum of three consecutive readings of 10 percent variability of less. The field parameters include: temperature, pH and specific conductance. In addition, the turbidity of the groundwater must achieve a reading of 50 Nephelometric Turbidity Units (NTUs) or less during the field parameter readings;
- All groundwater obtained during well development and sampling will be disposed of in accordance to DER-10;
- Groundwater sampling will occur, minimum of one week after development has been completed. A complete synoptic round of water levels will be taken prior to the start of groundwater sampling;
- Groundwater samples will be collected in accordance with low-flow groundwater sampling procedures. All groundwater samples will be submitted to and analyzed by Test America, Inc. for TCL VOCs +10, and TCL SVOCs +20. In addition, ten of these samples will be analyzed for TAL metals, total cyanide, total mercury, TCL PCBs, TCL chlorinated herbicides, pesticides via EPA Method 8081B, PFAS analyte list compounds via Methods based on EPA Method 537.1, and 1,4 dioxane via EPA Method 8270 SIM; and
- Investigation derived waste (IDW) generated (if any) from the installation of overburden and bedrock monitoring wells and the development and sampling of monitoring wells shall be handled in accordance with NYSDEC DER-10. Representative samples of cuttings and spoils may have to be analyzed to determine classification, treatment, and disposal.

Soil Vapor

- HRP will complete an offsite Soil Vapor Intrusion (SVI) investigation at the residence located at 35 Union Street, Ballston Spa, New York. This will include resampling of the residence to confirm analytical results from previous studies.

Data Review/ Validation and Analysis

- Review Category B data to complete Data Usability Summary Report (DUSR) in accordance with DER-10 guidance;
- Process all laboratory data obtained during the investigation through the NYSDEC EQuIS processor for validation; and
- Submit EQuIS approved EDD to the Department and DEC Project Manager.

Additional information is provided in the Site Specific Work Plan prepared for this Site under separate cover.

4.0 HAZARD ANALYSIS

The project hazard analysis below identifies the hazards that are anticipated to be encountered by the project team.

Physical Hazards Present	☐ Electricity ☒ Trips/Falls/Floor openings ☒ Holes/Pits ☐ Inclement weather ☒ Heat ☐ Cold ☐ Vibration ☐ Flying particles	☐ Ionizing radiation ☐ Non-Ionizing radiation ☐ Lasers ☒ Overhead hazards ☒ Noise ☐ Visible dust ☐ Falling objects ☐ Other ________________
Health/Chemical Hazards Present [1]	☐ Dust/Fumes/Particulates ☐ Flammable/Combustible ☐ Compressed gas ☐ Explosive ☐ Water reactive ☐ Unstable ☒ Contact with contaminated media	☐ Oxidizer ☐ Corrosive ☐ Toxic ☐ Highly Toxic ☐ Irritant ☐ Sensitizer ☐ Carcinogen/Mutagen ☐ Other ________________
Environmental/Equipment Hazards Present	☒ Heavy machinery ☒ Drilling ☐ Water operations ☐ Mobile equipment ☐ Road work ☐ Railroad work ☐ Forklifts ☐ Power tools ☐ Welding ☐ Gas cylinders ☒ Overhead/underground utilities	☒ Trenching/excavation ☐ Elevated heights/man lifts ☐ Scaffolding ☐ Ladders ☐ Confined spaces ☐ Energized equipment ☐ Overhead hazards ☒ Drums/container handling ☒ Insects/rodents/snakes ☐ Biological hazards ☐ Other ________________
Personal Safety Considerations	☐ Security Issues ☐ Remote setting ☐ Employees working alone ☐ Limited lighting	☐ Off hour shifts ☐ Dangerous wildlife/animals ☐ Limited cell phone service ☐ Other ________________

[1] **Table 1** (following the text of this HASP) provides a list of chemical substances for reference, along with odor threshold, permissible exposure limit (PEL), threshold limit value (TLV), OSHA ceiling, IDLH concentration, route of exposure and symptoms of acute exposure, if any.

Details of specific hazards associated with individual tasks will be discussed in the Daily Job Brief Record (**Appendix D**).

4.1 Hazard Analysis Summary / Minimization

HRP's Corporate Health & Safety Plan (in conjunction with this HASP) will be cross-referenced in order to obtain the safe work practice procedures for mitigating and preventing project site hazards identified in the table above. Job site hazard prevention and minimization information can be found in Section 3 of HRP's Generic Health & Safety Plan.

Confined Spaces

Only properly trained HRP personnel are authorized to enter confined spaces. Confined space entry may be performed by subcontractors who have the proper training and experience to conduct this work. Confined space entry is not anticipated during the RI.

Excavations

It is HRP's policy to ensure that for excavation projects the subcontracted environmental contractor will provide a competent person to perform daily and as needed inspections of excavation sites. This policy will be conveyed through the subcontract agreement with the environmental contractor. At a minimum HRP will provide our employees involved with construction projects with awareness level training regarding excavation hazards and notify the subcontracted firm if any obvious excavation safety hazard exists during the course of on-site activities.

Chemical Hazards

Hazardous chemicals known or suspected to be onsite are listed in **Table 1** (follows text). **Table 1** includes Chemical name, odor threshold OSHA PEL, ACGIH TLV, OSHA STEL, IDLH Concentrations, routes of exposure and symptoms of acute exposure. Chemicals likely to be encountered during site work are highlighted.

4.2 Changes in Conditions or Scope

Should conditions or the scope of work described herein change significantly; a HASP Addendum will be completed.

4.3 Monitoring Procedures

Air monitoring will be used to determine the concentrations of various chemicals while working in the exclusion zone to evaluate worker exposure to contaminated media. In order to determine potential health hazards and to determine the level of personal protection needed during sampling activities within the areas of concern, a Photoionization Detector (PID) will be periodically operated to monitor air quality for the purpose of ensuring minimal exposure to volatile organic compounds. Monitoring of atmospheres adjacent to on-going excavations and around the treatment area shall also be conducted with a PID.

The following environmental monitoring instruments/procedures shall be used on-site at the specified intervals.

Instrument/Procedure	**Sampling Interval**
Photoionization Detector (PID) in the breathing zone	Periodically as deemed by HSO

Background ambient air levels will be established outside the exclusion zone prior to commencement of site work. Ambient air sampling will occur in the breathing zone of site workers for comparison to the action levels (described below). Additionally, air sampling will be conducted in the vicinity of any intrusive exploration (i.e. near excavations, trenches, etc.) to determine if any contaminants are present.

The following *Action Levels* will be used:

Instrument	Action Level	Level of Protection or Action Required
PID	No reading above background	▪ No action required. ▪ Continue PID monitoring. ▪ (Modified) Level D protection.
PID	Up to 5 ppm above background	▪ Evacuate exclusion zone. ▪ Recheck levels after 15 minutes. ▪ If levels are sustained, reassess. ▪ Use engineering controls to lower breathing zone vapors. ▪ Level C protection (at the HSO direction).
PID	>5 ppm above background	▪ Evacuate exclusion zone. ▪ Recheck levels after 15 minutes. ▪ Use engineering controls to lower breathing zone vapors. ▪ If levels are sustained, contact Safety Manager, and re-evaluate HASP.

When an action level is equaled or exceeded, the work area should be evacuated and the area re-tested with the sampling device. If the appropriate action level continues to be exceeded, the HSO will have to assess the use of engineering controls to lower vapor levels or availability of required increased personal protection equipment before authorizing re-entry.

Calibration of all instruments will occur at least once per day, when in use. An equipment calibration log is included in **Appendix E.**

Community Air Monitoring

To ensure the protection of receptors surrounding the site HRP has developed and will implement a Community Air Monitoring Program (CAMP), which requires real time monitoring of volatile organics and dust during the remedial investigation. The CAMP, included as **Appendix F** will be implemented during all intrusive activities.

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater than the background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work will 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/m3 of the upwind level and in preventing visible dust migration.

5.0 ENGINEERING CONTROL MEASURES/GENERAL SAFETY

5.1 Air Monitoring

In order to determine potential health hazards and to determine the level of personal protection needed during drilling, excavation and sampling activities within the areas of concern, a PID will be periodically operated to monitor air quality for the purpose of ensuring minimal exposure to volatile organic compounds. Please refer to Section 4.2 of this plan for specific air monitoring procedures/action levels.

5.2 Protective Zones

Prior to commencement of work in area of suspected contamination, protective zones specific for each phase of the Plan will be established by the HSO if necessary prior to the start of field work. The purpose of the protective zones is to prevent potential cross-contamination of adjacent areas as well as to protect project personnel from exposure to contaminated areas.

Protective zones shall be delineated as follows:

- <u>Exclusion Zone:</u> This is the contaminated area in which intrusive activities are performed. The “Area of Environmental Concern” (AOEC) is located within this area. A single access point for entrance and exit should be established and maintained, if possible. This zone should be delineated from the Contaminant Reduction Zone via perimeter cones or caution tape, or other applicable method. Work areas are shown on **Figure 2**. The Exclusion Zone delineation and any necessary modifications will be based on site conditions.

- <u>Contaminant Reduction Zone:</u> This zone is a transition zone located between the Exclusion Zone and the Support Zone and is utilized to decontaminate personnel and equipment.

- <u>Support Zone:</u> This zone will be utilized by equipment and vehicle storage and will be kept free of contaminated material. The HSO will determine the location of this zone. In the event of a site evacuation, the rally point will be <u>on the southwestern side of the car wash building (**Figure 2**)</u>. The designated rally point may be relocated by the HSO based on project or site conditions. All site workers will be notified of any relocation prior to implementation.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

6.1 Level of Protection

As identified in Section 4.0, the overall health and safety risk associated with chemical hazards for HRP and associated contractors is considered significant. This is primarily due to the moderate concentrations of chemical contaminants expected based on minimal contact personnel will have with any potentially contaminated media. Therefore, the minimal level of protection for HRP personnel during the conduct of all the environmental work performed at the site will be Level D PPE, and will generally consist of the PPE listed below:

- Steel toe/shank work boots
- Hard hat, as necessary
- Safety vest, as necessary
- Coveralls/tyvek, as necessary
- Safety glasses/goggles/face shield, as necessary
- Hearing protection, as necessary

If site conditions warrant, an upgrade to Level C PPE may be required (refer to Section 4.2 for the appropriate *Action Levels*) then the contractors will make Level C personal protective equipment (PPE) readily available. Level C PPE generally includes:

- Full face, air purifying respirator with organic vapor cartridges
- Same as Level D, but also includes tyvek taped pant/boot and glove/shirt

If it is determined protection beyond Level C is required, HRP will re-evaluate the HASP as well as the site conditions, and will revise the HASP as required. The following table provides a summary of the minimum level of PPE required on site:

Description	Level of Protection [1]	
	D	C
Body		
Work Clothes	R	R
Chemical Protective Suit (Tyvek)	O	R
Visibility Vest	O [2]	O [2]
Apron	O	O
Fall Protection	O [2]	O [2]
Head		
Hard Hat	R	R
Head Warmer	O	O
Eyes & Face		
Safety Glasses	R	R
Goggles (based on hazard)	O	R
Face Shield	O	O
Ears		
Plugs or Muffs	R [2]	R [2]
Hands & Arms		
Work Gloves	R	O [2]

Description	Level of Protection [1]	
	D	C
Chemical Resistant Gloves (Nitrile)	O	R
Insulated Gloves	O	O
Foot		
Work Boots/Steel Toe Boots	R	R
Chemical Resistant Boots	O	O
Disposable Boot Covers	O	O
Respiratory Protection [3]		
½ Mask Air Purifying Respirator (APR) or Full face APR	NA	R
Dust Protection	O	NA
Powered APR	NA	NA
SCBA/Supplied Air Respirator	NA	NA

R = Required, **O** = Optional, **NA** = Not Applicable

[1] The level of protection identified here does not include the necessary equipment for entering confined spaces. Refer to Moran Environmental Recovery's Safety Manual Confined Space Program for atmospheric sampling protocols and breathing and rescue equipment necessary for those operations.

[2] The use of this PPE may or may not be required depending on site conditions/location and will be addressed at the time of task assignment by the HSO.

[3] Respiratory protection necessary to protect against VOC, dusts/particulates and not oxygen deficient atmospheres.

The following table provides a general description of potential field activity tasks to be performed and associated (recommended) PPE. The use of this PPE may or may not vary depending on site conditions and will be addressed at the time of task assignment by the HSO.

Task Description	Invasive (Y/N)	Protection Level
Site Mobilization - Surveying, fence and barrier installation, hay bale installation, decon and work zone set up, soil staging areas preparation	N	Level D
Soil and Water Sampling - Drilling, sampling, soil moving as needed.	Y	Modified Level D or Level C – Respirator as needed based on monitoring. Eye protection required during collection of any liquid sample
Soil Excavation, Staging and Load-Out	Y	Modified Level D – or Upgrade to Level C dependent on monitoring
Decontamination - Truck dry sweeping, decon pressure wash of equipment, PPE change out	Y	Modified Level D – or Upgrade to Level C dependent on monitoring
Waste Management - Soil load-out for off-site disposal, water removal for disposal, PPE disposal	Y	Modified Level D – or Upgrade to Level C dependent on monitoring
Site Control (Exclusion, Decontamination, Support Zones)	N	Modified Level D – or Upgrade to Level C dependent on monitoring
Communications - Use of hand signals, backup alarms, and voice	N	NA
Site Restoration	Y	Level D

7.0 DECONTAMINATION

7.1 Decontamination Procedures

All personnel and equipment leaving the exclusion zone must be properly cleaned and decontaminated. When there is evidence of chemical contamination during the site operations, all personnel will be decontaminated under the direction of the HSO. Clean-up and/or decontamination of personnel shall consist of washing off excessively soiled PPE with a disinfectant detergent scrub and water. At the very least, all personnel should wash their hands and face before leaving the exclusion zone. After washing, all disposable clothing (tyvek, gloves, etc.) will be removed and placed in a double lined plastic bag.

Sampling tools and any other non-disposable items will be decontaminated between sampling points, and at the direction of HRP personnel, to prevent cross-contamination of work areas or environmental samples, as applicable.

7.2 Emergency Decontamination

If immediate medical attention is required in an emergency, decontamination will be performed after the victim has been stabilized. If a worker has been exposed to an extremely toxic or corrosive material, then emergency decontamination will consist of flushing with copious amounts of water. If the victim cannot be decontaminated because it will interfere with emergency medical aid being administered, then the victim should be wrapped with plastic or other available items (i.e. an uncontaminated coverall) to reduce potential contamination of other personnel or medical equipment.

If a site worker has been overcome by heat related illness, then any protective clothing should be removed immediately. In the case of non-medical emergency evacuation, decontamination should be performed as quickly as possible, unless instant evacuation is necessary to save life or prevent injury.

7.3 Personal Hygiene

All employees will be required to wash hands and face prior to eating, smoking, drinking and going to the bathroom. Workers will be required to remove contaminated PPE and clothing prior to leaving the Contaminant Reduction Zone. All field personnel should avoid contact with potentially contaminated substances such as puddles, pools, mud, etc.

Additional personal hygiene requirements, intended to prevent the spread of the novel corona virus to site workers will be in effect during site activities. These procedures include mobile handwashing stations and the requirement for site workers to wear face coverings. Additional details are included in **Appendix G**.

8.0 EMERGENCY ACTION PLAN/SPILL RESPONSE

In the event of a worker injury, fire, explosion, spill, flood, or other emergency that threatens the safety and health of site workers, the following procedure will be followed:

1. If the emergency originates within the work area covered by this Plan, the HRP HSO shall act as the Emergency Coordinator. The emergency evacuation signal is an air horn or a loud yell. All emergency situations (including worker injuries, no matter how small) will be reported to the HSO, who will determine the appropriate emergency response, up to and including evacuation. Only the HSO may initiate evacuation of the work area. The HSO will be responsible for reporting any emergency situation to the appropriate authorities, using a telephone or other appropriate method.

2. In the case of an evacuation, site workers will exit the site along the safest route(s) and assemble with team members at a safe rally point. Those workers in the Exclusion Zone will follow the emergency decontamination procedures outlined in Section 7.2. Accounting of all site personnel will be conducted by the HSO using the personnel log at a location determined by the HSO.

3. HRP personnel are not permitted to participate in handling the emergency. Fire and medical emergencies will be handled by the local fire department and ambulance service. In the case of a spill of hazardous materials the NYSDEC will be contacted.

   In addition, the HSO/Project Manager must advise the site contact that the New York Spill Hotline should be contacted and, if the spill quantity is greater than the Reportable Quantity (RQ) under CERCLA and/or SARA, the National Response Center (NRC) and Local Emergency Planning Committee should also be contacted. If the spill begins to flow overland and threatens to contaminate a storm drain or surface water, HRP personnel may attempt to contain and isolate the spill using any available resources, but only if, in the judgment of the HSO, such action will not expose the workers to dangerous levels of hazardous substances and is necessary to preserve life or property. In the event that a spill of material of any amount threatens to reach navigable waters, the NRC shall be contacted.

4. Once initial emergency procedures to protect worker safety and health have been addressed, and control of emergency has been completed, the HSO will complete an Investigation Report and submit this form to the appropriate personnel (HRP and/or client contact).

5. All site workers will be familiarized with the above procedures during the pre-entry briefing to be conducted before site work begins.

9.0 TRAINING/MEDICAL SURVEILLANCE

9.1 Training Requirements

All HRP and HRP subcontractor personnel who enter the work zone and/or Exclusion Zone must have successfully completed the 40-hour or 24-hour training requirement outlined in 29 CFR 1910(e). If the 40-hour or 24-hour training of any person occurred more than 12 months prior to commencement of work, then that person must have attended an 8-hour refresher course within the 12 months prior to commencement of work. If respirators are in use in the Exclusion Zone, then all personnel must have undergone respirator training and a fit test within the last 12 months. Training certificates and records for HRP employee(s) are on file at HRP. All other contractors will be required to supply written proof of training before being allowed into the Exclusion Zone.

9.2 Pre-Entry Briefing

Prior to commencement of work in an area of suspected contamination, HRP's Health and Safety Officer will conduct a pre-entry briefing with on-site contractors, which will include the following:

- Name of the HSO and person responsible for the visitor log.
- Description of the parcel as well as location of emergency telephones and the location/boundaries of the Exclusion Zone, Contamination Reduction Zone, and Support Zone, if established.
- Review of hospital locations and directions.
- Review of tasks to be conducted within the parcel by the site workers.
- Review of the Emergency Action Plan and rally point, including the nearest emergency communications and telephone numbers.
- The nature, level, and degree of anticipated hazards (physical and chemical) involved in the site work.
- Required personal protective equipment.
- Decontamination procedures.

The HSO should also, at this time, ensure that all on-site HRP and HRP subcontractor personnel have read the HASP and signed the last page of the original (Section 11.0). If additional information on the site becomes available, the HSO will call additional briefings as necessary.

9.3 Morning Safety (Tailgate) Meeting

The HRP HSO will conduct a safety overview meeting at the beginning of each workday on the site. The meeting will be given in addition to any tailgate meetings that the subcontractor conducts. A summary of the meeting topics signed by the personnel attending the meeting is included in **Appendix D**.

9.4 Medical Surveillance

All HRP and HRP subcontractor personnel entering the Exclusion Zone must have had a physical within the 12 months prior to commencement of site work. A physician's written opinion regarding fitness for work for each employee including work limitations, if any, is on file at HRP, as applicable. A written opinion for all other site personnel must be supplied prior to commencement of site work to the HRP HSO. Any work limitations for site personnel, or relevant medical information (i.e. allergic reactions to medication) should be included in this Plan.

10.0 AUTHORIZATIONS

Personnel authorized to enter the Exclusion Zone include the personnel listed in Section 2.4. Persons not listed in Section 2.4 may enter the Exclusion Zone only if the appropriate training and medical fitness certifications have been supplied to either the HRP Project Manager or Health and Safety Manager and the HSO or his/her designee on site has approved site entry. All personnel entering or leaving the Exclusion Zone must sign in and sign out with the recordkeeper.

11.0 FIELD TEAM REVIEW

All HRP personnel shall sign below after reading this HASP and shall agree with the following statement:

> *"I have read and understand this site specific Health and Safety Plan.
> I will comply with the provisions set forth therein."*

Printed Name	**Signature**	**Date**

12.0 APPROVALS

This plan meets the minimum requirements of 29 CFR 1910.120 and 29 CFR 1929.65 and has been written for specified site conditions, dates, and personnel, and must be amended if conditions change. By their signature, the undersigned certify that this HASP is approved and will be utilized during activities at the project.

May 6, 2020
Stefan Truex, PG
On-Site Health and Safety Officer
Date

Mark Wright
May 6, 2020
Mark Wright, PG, CHIMM, CSP
Project Manager
Date

Mark Wright
May 6, 2020
Mark Wright
Office Health and Safety Manager
Date

Subcontractor:

I have been provided a copy of this HASP for review.

____ ______________
[name] Date

Representing ____

The Designated Competent person representing [subcontractor] at the site will be

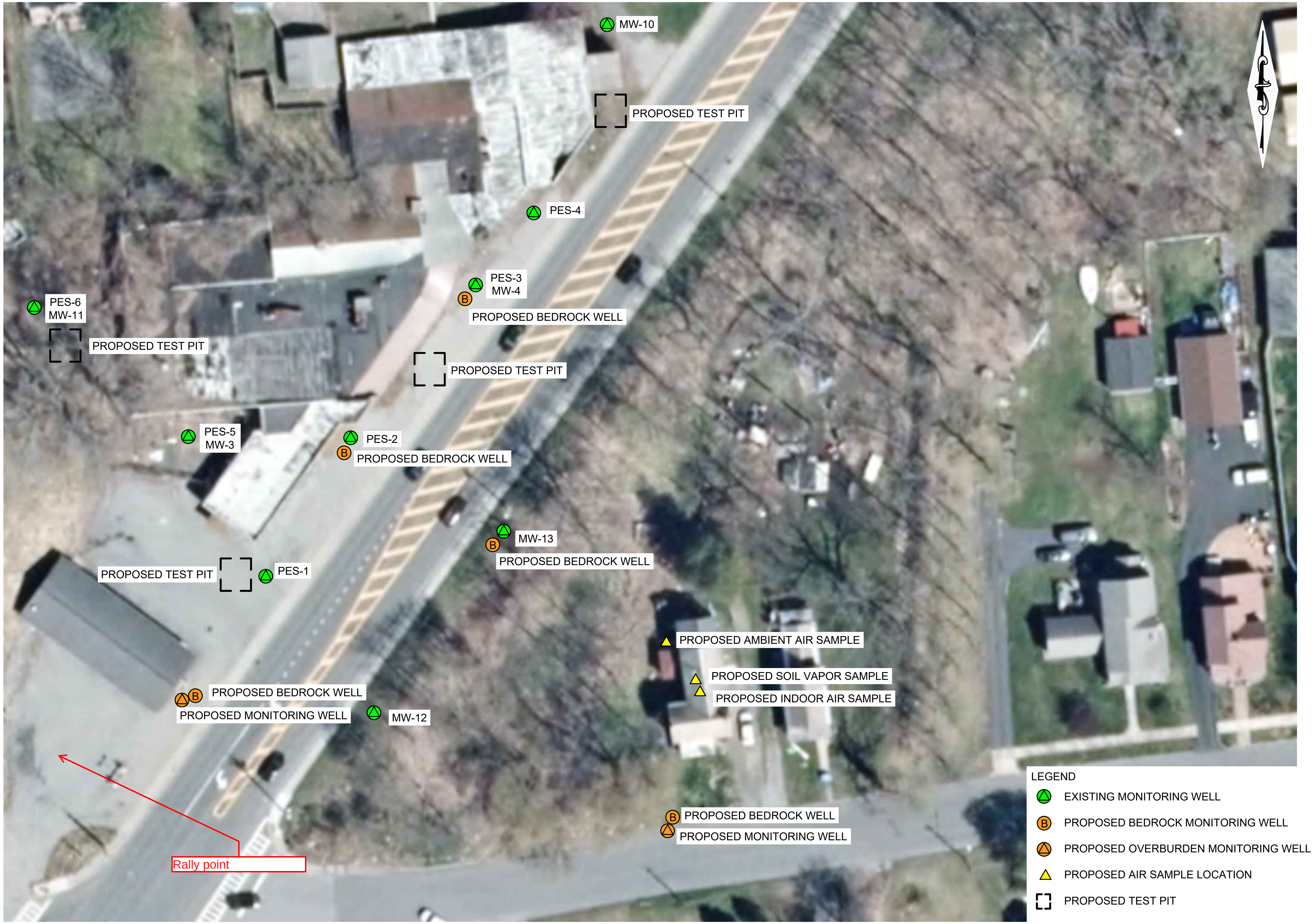
____________________________________.

Any alternate Competent Person will be noted in the Daily Job Brief Record (**Appendix D**).

ADDITIONAL APPROVALS (or Re-Approvals)

Name:	Date:

FIGURES



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NO.	DATE

DESIGNED BY: SRT
DRAWN BY: SRT
REVIEWED BY: MEW

ISSUE DATE: 3/20/2020
PROJECT NUMBER: DEC1001.P3
SHEET SIZE: 11"x17"

Proposed Investigation Locations

FORMER RICKETT'S DRY CLEANERS
REMEDIAL INVESTIGATION

2017-2019 DOUBLEDAY AVENUE
BALLSTON SPA, NEW YORK 12020

FIGURE
2

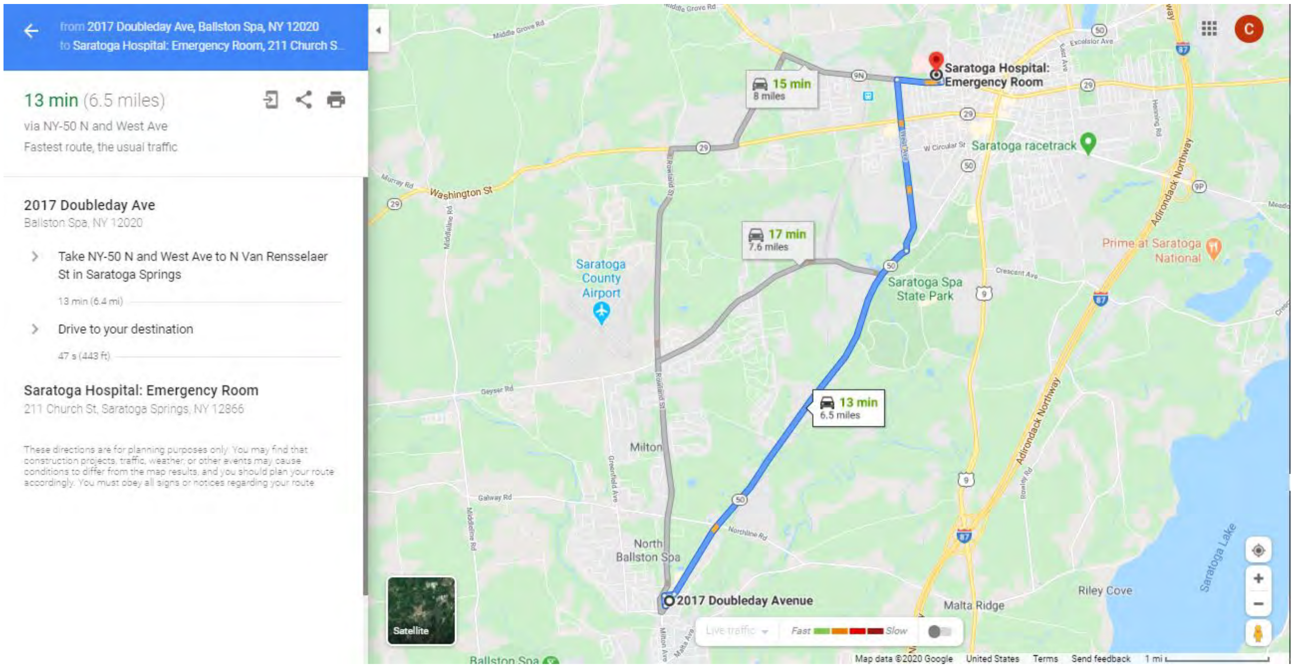
DRAWING NAME: S:\Data\N\NYDEC - NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION\MILTON\2017 DOUBLEDAY AVENUE, BALLSTON SPA (MILTON), NY\DEC1001P3\CAD\2020-03-20_ProposedSubsurfaceInvestigationLocations.dwg LAYOUT: RICKETTS Figure 1 PLOT DATE: Mar 20, 2020 - 2:35pm OPERATOR: $(GETVAR,??)

Figure 3: Route and Map to Nearest Hospital and Medical Center

Directions to Saratoga Hospital

Total Estimated Time: 13 minutes
Total Estimated Distance: 6.5 miles

End at Saratoga Hospital
211 Church Street, Saratoga Springs, NY



from 2017 Doubleday Ave, Ballston Spa, NY 12020
to Saratoga Hospital: Emergency Room, 211 Church S...

13 min (6.5 miles)
via NY-50 N and West Ave
Fastest route, the usual traffic

2017 Doubleday Ave
Ballston Spa, NY 12020

- Take NY-50 N and West Ave to N Van Rensselaer St in Saratoga Springs
  13 min (6.4 mi)
- Drive to your destination
  47 s (443 ft)

Saratoga Hospital: Emergency Room
211 Church St, Saratoga Springs, NY 12866

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

TABLES

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL[1]	TLV (ACGIH)	OSHA CEILING[2] /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE[3]
1,1,1 Trichloroethane	44 ppm	350 ppm	350 ppm	---	700 ppm	Inh, Ing, Con	Head, Lass, CNS, Derm
1,1,2-Trichloroethane	---	10 ppm	10 ppm	----	[100 ppm]	Inh, Ing, Abs, Con	Eyes, Nose Irrit, Resp Irrit, CNS, Liver, Kidney Damage, Derm, [Carc]
1,2,4 Trimethylbenzene 1,3,5 Trimethylbenzene		25 mg/m^3	25 ppm	25 mg/m^3	ND	Inh, Ing, Con	Irrit Eyes, Skin, Nose, Throat, Resp Sys, Bron, Hyprochronic Anemia, Head, Drow, Ftg, Dizz, Nau, Inco, Vomit, Conf, Chemical Pneu (aspir lig)
1,1' Biphenyl	0.0062 mg/m^3	0.2 ppm	0.2 ppm	---	100 mg/m^3	Inh	
1,1-Dichloroethane	120 ppm	100 ppm	100 ppm	---	3,000 ppm	Inh, Ing, Con	CNS Depres, Skin Irrit, Liver, Lung and Kidney Damage
1,1-Dichloroethylene***	500 ppm	---	5 ppm	---	---	Inh, Con	CNS depress, Resp, [Carc]
1,2-Dichlorobenzene	50 ppm	50 ppm	25 ppm		200 ppm	Inh, Ing, Abs, Con	Irrit, Resp
1,2-Dichloroethylene	26-87 ppm	200 ppm	200 ppm	---	1,000 ppm	Inh, Ing, Con	Vomit, Irrit Eyes, Resp Sys; CNS Depres
1,2-Dichloropropane	130-190 ppm	75 ppm	75 ppm	---	[400 ppm]	Inh, Con, Ing	Eye irritation, Drow, light-headedness; irritated skin, [Carc]
1,3-Dichlorobenzene	---	----	---	----	---	----	----
1,4-Dichlorobenzene	20 ppm	75 ppm	10 ppm	----	[150 ppm]	Inh, Ing	[Carc], Eye Irrit, swelling around eye, headache, nausea, vomiting
1-Methylnaphthalene	0.02 ppm	---	---	---	---	---	---
2,4-Dichlorophenol	1.4007 mg/m^3	---	---	---	---	---	---
2,4-Dimethylphenol	0.001 mg/m^3	---	---	---	---	---	---
2-Methylnaphthalene	0.01 ppm	---	---	---	---	---	---
2-Methylphenol (o-cresol) [skin]	1.4 mg/L	5 ppm	5 ppm	---	250 ppm	Inh, Abs, Ing, Con	Confusion, depression, Resp Fail; difficulty breathing, irregular rapid respiration, weak pulse; skin, eye burns; dermatitis

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL[1]	TLV (ACGIH)	OSHA CEILING[2] /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE[3]
3, 3'-Dichlorobenzidine	---	None	---	---	---	Inh, Abs, Ing, Con	Sens, Derm, Head, Dizz, Burns, GI Upset, [Carc]
4-Isopropyltoluene	---	---	---	---	---	Con, Inh, Ing	Defat, Eryt
Acenephthene	0.5048 mg/m^3	---	---	---	---	---	---
Acenaphthylene	---	---	---	---	---	---	---
Acetone	47.5 mg/m^3	1,000 ppm	500 ppm		2,500 ppm	Ing, Inh, Con	Head, Dizz; Irrit Eyes, Nose, Throat; Derm, CNS, Depress, Derm
Acetonitrile	70 mg/m^3	40 ppm	20 ppm	---	500 ppm	Inh, Ing, Abs, Con	Asphy; Nau, Vomit; Chest Pain; Weak, Stupor, Convuls; Eye Irrit
Aldrin	---	0.25 mg/m^3	0.25 mg/m^3	---	25 mg/m^3	Inh, Abs, Ing, Con	Head, Dizz, Nau, Vomit, Mal, Myo, [Carc]
Anthracene (Coal Tar Pitch)	---	0.2 mg/m^3			[80 mg/m^3]	Inh, Con	Derm, bron, [carc]
Antifreeze		50 ppm	100 mg/m^3 (aerosol)	---	ND	Inh, Ing, Con	Irrit Eyes, Skin, Nose, Throat, Nau, Vomit, Abdom Pain, Lass, Dizz, Stup, Conv, CNS, Depres, Skin Sen
Arsenic	----	0.010 mg/m^3	0.01 mg/m^3	----	[5 mg/m^3]	Abs, Inh, Con, Ing	Derm; GI; Resp Irrit; ulceration of nasal septum; Resp, Irrit, Hyper Pig of Skin, [Carc]
Barium (elemental)	---	0.5 mg/m^3	0.5 mg/m^3		50 mg/m^3 (barium components)	Inh, Ing, Con	Resp. Irrit, GI, Muscle Spasm, Eye Irrit, Slow Pulse; skin burns
Benzene*	4.7 ppm	1 ppm	0.5 ppm	5 ppm	[500 ppm]	Inh, Ing, Abs, Con	Irrit Eyes, Nose, Throat; Head, Nau, Derm, Ftg, Anor, Lass, [Carc]
Benzo(a)anthracene (coal tar pitch)	---	0.2 mg/m^3			[80 mg/m^3]	Inh, Con	[Carc], Derm, Bron
Benzo(a)pyrene (coal tar pitch)	---	0.2 mg/m^3	---		[80 mg/m^3]	Inh, Con	[Carc], Derm, Bron
Benzo(b)fluoranthene (coal tar pitch)	---	0.2 mg/m^3	---		[80 mg/m^3]	Inh, Con	[Carc], Derm, Bron

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL^1	TLV (ACGIH)	OSHA CEILING^2 /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE^3
Benzo(g,h,i)perylene (coal tar pitch)	---	0.2 mg/m^3			[80 mg/m^3]	Inh, Con	[Carc], Derm, Bron
Benzo(k)fluoranthene (coal tar pitch)	---	0.2 mg/m^3			[80 mg/m^3]	Inh, Con	[Carc], Derm, Bron
Bis (2-ethylhexyl) Phthalate**	N/A	5 mg/m^3	5 mg/m^3	10 mg/m^3	[5,000 mg/m^3]	Inh, Ing, Con	[Carc], Irrit Eyes
Cadmium (dust)	---	0.005 mg/m^3	Lowest concentration feasible 0.01 mg/m^3	---	[9 mg/m^3]	Inh, Ing	CNS, Resp, Irrit, Vomit, Cough, Head, Chills, Nau, Diarr, Pulm Edema, Dysp, Chest Tight, [Carc]
Carbazole	---	---	---	---	---	Inh	---
Carbon disulfide	0.1-0.2 ppm	20 ppm	1 ppm	30 ppm	500 ppm	Inh, Abs, Ing, Con	Diz, Head,Ftg, Ner, anorexia, trembling hands, loss of fine motor coord, gastritis, eye, skin burns, Derm
Carbon Tetrachloride***	21.4 ppm	10 ppm	5 ppm	25 ppm	[200 ppm]	Inh, Abs, Con, Ing	CNS Depres, Nau, Vomit, Irrit, Irrit Eyes, Skin, Drow, Dizz, [Carc]
Chlorobenzene***	0.98 mg/m^3	75 ppm	10 ppm	---	1,000 ppm	Inh, Ing, Con	Irrit, Drow, CNS, Depres, Eyes, Skin, Nose, Inco.
Chloroform***	85 ppm	50 ppm	10 ppm	50 ppm	[500 ppm]	Inh, Ing. Con, Abs	Dizz, Dullness, Nau, Head, Ftg, Irrit Eyes, Skin, Conf, [Carc]
Chromium	---	1 mg/m^3	0.5 mg/m^3	---	250 mg/m^3	Inh, Ing, Con	Irrit Eyes, Sens Derm
Chrysene (coal tar pitch)		0.2 mg/m^3	---		[80 mg/m^3]	Inh, Con	Derm, Bron, [Carc]
Cis-1-2-Dichloroethylene	---	200 ppm	200 ppm	----	1000 ppm	Inh, Con, Ing	Irrit Eyes, Resp, CNS Depress
Copper (dusts and mists) (fumes)		1 mg/m^3 0.1 mg/m^3	1 mg/m^3 0.2 mg/m^3	----	100 mg/m^3	Inh, Ing, Con	Vomit, Derm, CNS, Irrit, Derm, Nau, Taste (metallic)
Cyanide	0.9 mg/m^3	5 mg/m^3	5 mg/m^3 (10 min)	5 mg/m^3	25 mg/m^3	Inh, Ing, Abs, Con	Weak, Head, Nau, Conf, Cyan
Dibenzo(a,h)anthracene						Inh, Ing	
Dichloromethane	540 mg/m^3	25 ppm	50 ppm	125 ppm	[2,300 ppm]	Inh, Abs, Ing, Con	Irrit Eyes, Skin, lass, drow, dizz, Numb, tingl, Nau, [Carc]

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL[1]	TLV (ACGIH)	OSHA CEILING[2] /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE[3]
Diethylphthalate**	---	None	5 mg/m^3	---	N.D.	Inh, Ing, Con	Irrit Eyes, Skin, Nose, Throat, Head, Dizz, Nau, Lac, Possible Polyneur, Vestibular Dysfunc, Pain, Numb, lass, Spasms in Arms and Legs
Di-n-octylphthalate	---	---	---	---	---	Inh, Ing, Con	---
Dimethylpthalate	---	5 mg/m^3	5 mg/m^3	---	2,000 mg/m^3	Inh, Ing, Con	Irrit, Resp, Abdom
Ethyl Benzene*	8.7 mg/m^3	100 ppm	100 ppm	125 ppm	700 ppm	Inh, Abs, Con	Head. Irrit, Derm, Narc., Irrit Eyes, Skin; Coma
Fluoranthene		0.2 mg/m^3	0.2 mg/m^3			Ing, Inh	[Carc]
Fluorine*	6 mg/m^3	0.1 ppm	1 ppm	2 ppm	25 ppm	Inh, Con	
Fuel Oil/#2	----	----	300 ppm	----		Inh, Abs, Ins, Con	Irrit Eyes, Skin, Derm, Head, Ftg, Blurred Vision, Dizz, Conf
Ideno(1,2,3-cd)pyrene		0.2 mg/m^3				Ing, Inh	
Lead (inorganic forms and dust as Pb)****		0.05 mg/m^3	0.05 mg/m^3		100 mg/m^3	Inh, Ing, Con	Irrit, Cns, Vomit, Narco, Weak, Pall, Insom, Lass, Abdom, Constip
Mercury (organic alkyl compounds) [skin]		0.01 mg/m^3	0.01 mg/m^3	0.03 mg/m^3	2 mg/m^3	Inh, Abs, Ing, Con	Irrit Eyes, Skin; Cough & Chest Pain, Bron Pneu, Tremor, Insom, Irrty, Indecision, Head, Ftg, Weak, Stomatitis, Salv, GI Dist, Anor, Low-wgt, Ataxia
Mercury (compounds)	----	0.1 mg/m^3	0.025 mg/m^3	0.1 mg/m^3	10 mg/m^3	Inh, Abs, Ing, Con	Irrit Eyes, Skin; Cough & Chest Pain, Bron Pneu, Tremor, Insom, Irrty, Indecision, Head, Ftg, Weak, Stomatitis, Salv, GI Dist, Anor, Low-wgt, Ataxia
Methanol	13.1150 mg/m^3	200 ppm	200 ppm	---	6,000 ppm	Inh, Abs, Ing, Con	Irrit Eyes, Skin, Resp, Head, drow, dizz, Nau, Vomit, vis dist, Optic, derm
Methyl Ether	----	----	---	----	---	Inh	Poison

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL^1	TLV (ACGIH)	OSHA CEILING^2 /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE^3
Methyl Ethyl Ketone (2-Butanone)***	0.7375 mg/m^3	200 ppm	200 ppm	300 ppm	3,000 ppm	Inh, Con, Ing	Irrit Eyes, Skin, Nose, Throat, Head, Dizz, Vomit, Derm
Methylene Chloride	540 mg/m^3	25 ppm	50 ppm	125 ppm	[2,300 ppm]	Inh, Ing, Con, Abs	Ftg, Weak, dizz, drow, Numb, Tingle [carc], Irrit Eyes, Skin, Nau
Mineral Spirit	20 ppm	500 ppm	100 ppm	---	20,000 mg/m^3	Inh, Ing, Con	Irrit Eyes, Nose, Throat, Dizz, Derm, Chemical pneu
Methyl tert butyl ether (MTBE)	---	---	50 ppm	---		Inh, Abs	
Naphtha	0.86 ppm	100 ppm	400 ppm	---	1,000 ppm	Inh, Con, Ing	Light Head, Drow, Irrit, Derm, Irrit Eyes, Skin, Nose
Naphthalene*	0.084 ppm	10 ppm	10 ppm	15 ppm	250 ppm	Inh, Abs, Ing, Con	Eye irritation; headache; confusion, excitement, malaise (vague feeling of ill-being); nausea, vomiting, abdominal pain; irritated bladder; profuse sweating; renal shutdown; dermatitis
Nickel (metal)	---	1 mg/m^3	1.5 mg/m^3	---	[10 mg/m^3]	Inh, Ing, Con	Head, Verti, Nau, Vomit, Pain, Cough, Weak, Convuls, Delirium, Pneu, ,[Carc]
Nitrobenzene	0.0235 mg/m^3	1 ppm	1 ppm	---	200 ppm	Inh, Abs, Ing, Con	Irrit Eyes, Skin, Anoxia, Derm, Anem, Methem
n-Butylbenzene	---	---	---	---	---	---	---
n-Propylbenzene	---	---	---	---	---	---	---
PCBs 42% chlorine (Aroclor 1242)	---	1 mg/m^3 (skin)	1 mg/m^3 (skin)	---	[5 mg/m^3]	Inh, Abs, Ing, Con	Irrit Eyes, Chloracne, Liver Damage [carc]
PCBs 54% chlorine (Aroclor 1254)	---	0.5 mg/m^3 (skin)	0.5 mg/m^3 (skin)	---	[5 mg/m^3]	Inh, Abs, Ing, Con	Irrit Eyes; Chloracne, Liver Damage [carc]
Petroleum Distillates	---	500 ppm	100 ppm		[1,100 ppm]	Inh, Ing, Con	Dizz, Drow, Head, Dry Skin, Nau, Irrit Eyes, Nose, Throat, [Carc]

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL^1	TLV (ACGIH)	OSHA CEILING^2 /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE^3
Phenanthrene (Coal Tar Pitch)		0.2 mg/m^3	0.2 mg/m^3		[80 mg/m^3]	Inh, Con	Derm, bron, (carc)
Phenol**	0.1786 mg/m^3	5 ppm	5 ppm	---	250 ppm	Inh, Abs, Ing, Con	Irrit Eyes, Nose, Throat, Anor, Low Wgt, Weak Musc Ache, Pain, Dark Urine, Cyan, Liver, Kidney Damage, Skin, Burns, Derm, Ochronosis, Tremor, Convuls, Twitch
Pyrene		0.2 mg/m^3			[80 mg/m^3]	Inh, Con	[Carc]
Sec-Butylbenzene	---	---	---	---	---	---	---
Selenium	N/A	0.2 mg/m^3	0.2 mg/m^3	Unknown	1 mg/m^3	Inh, Ing, Con	Irrit, Head, Fever, Chills, Skin/Eye Burns, Metallic Taste, GI, Dysp, Bron
Silver (metal and soluble compounds as Ag)	----	0.01 mg/m^3	Metal = 0.1 mg/m^3 Soluble 0.01 mg/m^3		10 mg/m^3	Inh, Ing, Con	Blue-gray Eyes, Nasal Septum, Throat, Skin; Irrit, Ulcer, Skin, GI Dist
Tetrachloroethylene (a.k.a. perchloroethylene)***	4.68 ppm	100 ppm	25 ppm	200 ppm	[150 ppm]	Inh, Ing, Con, Abs	Irrit Eyes, Skin, Nose, throat, Resp. Nau, flush face, Neck, dizz, inco, head, drow, eryth, [Carc]
Toluene*	2.14 ppm	200 ppm	50 ppm	300 ppm	500 ppm	Inh, Abs, Ins, Con	Resp, Irrit, Ftg, Conf, Dizz, Head, Derm, Euph, Head, Dilated Pupils, Lac, Ner, Musc FTg, Insom, Pares, Derm, lass
Petroleum Distillates (naphtha)	10 ppm	100 ppm	400 ppm	---	1,000 ppm	Con, Inh, Ing	---
Trans 1,2-Dichloroethylene	0.3357 mg/m^3	200 ppm	200 ppm	---	1,000 ppm	Inh, Con	Irrit, Resp, CNS depress
Trichloroethylene***	21.4 ppm	100 ppm	50 ppm	200 ppm	[1,000 ppm]	Inh, Con, Abs, Ing	Head, Vert, Nau, Vomit, Derm, Vis Dist, Tremors, Som, Nau, Irrit Eyes, Skin, Card Acc., Ftg, [Carc]
Trichlorofluoromethane	28 mg/m^3	1,000 ppm	1,000 ppm		2,000 ppm	Inh, Con, Ing	Inco, trem, derm, card, asph, frost

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL[1]	TLV (ACGIH)	OSHA CEILING[2] /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE[3]
Trichlorotrifluoroethane	45 ppm	1,000 ppm	1,000 ppm	1,250 ppm	2,000 ppm	Inh, Con, Ing	Irrit Skin, throat, Drow, Derm, CSN, Depress
Vinyl Chloride***	10-20 ppm	1 ppm	1 ppm	5 ppm	ND	Inh, Con	Lass, Abdom, Gi Bleeding; Hepatomegaly; Pallor or Cyan of Extremities; Liq: Frostbite; [Carc]
VM&P Naphtha (petroleum naphtha)	---	---	300 ppm	---	ND	Con, Ing, Inh	Irrit Eyes, Nose, Throat, Dizz, drow, head, nau, dry skin, chem. Pneumonitis
Xylene*	4.5 mg/m^3	100 ppm	100 ppm	150 ppm	900 ppm	Inh, Ing, Abs, Con	Dizz, Drow, Irrit, Excite, Nau, Vomit, Eyes, Skin, Nose, Throat
Zinc (oxide)	---	5 mg/m^3	2 mg/m^3	---	500 mg/m^3	Inh	Dry Throat, Cough, Chills, Tight Chest, Blurred Vision
4,4' DDD	---	---	---	---	---	Ing, Inh, Con	---
4,4' DDE	---	---	---	---	---	Ing, Inh, Con	---
4,4' DDT	5.0725 mg/m^3	1 mg/m^3	1 mg/m^3	---	[500 mg/m^3]	Inh, Abs, Ing, Con	Irrit Eyes, Skin, Pares, Tongue, Lips, Face, Trem, Anxi, Dizz, Conf, Mal, Head, Lass, Conv, Paresi Hands, Vomit, [Carc]
Aldrin		0.25 mg/m^3	0.25 mg/m^3	---	[25 mg/m^3]	Inh, Abs, Ing, Con	Head, Dizz, Nau, Vomit, Mal, Myo [Carc]
Chlordane [skin]	0.0084 mg/m^3	0.5 mg/m^3	0.5 mg/m^3		[100 mg/m^3]	Inh, Abs, Ing, Con	Blurred vision, confusion, delirium, cough; abdominal pian, nausea, vomiting diarrhea; irritability, tremor, convulsions [Carc]
EDB	76.8 mg/m^3	20 ppm		30 ppm	[100 ppm]	Inh, Abs	Resp. Irr, Eye Irr. [Carc]
Endosulfan I Endosulfan II	---	0.1 mg/m^3	0.1 mg/m^3	---	N.D.	Inh, Abs, Ing, Con	Irrit, Skin, Nau, Conf, Agit, Flush, Dry, Trem, Conv, Head
Endosulfan Sulfate		---	0.1 mg/m^3	---	---	Ing, Con	---
Endrin	1.8 x 10^{-2} ppm	0.1 mg/m^3	0.1 mg/m^{-3}	---	2 mg/m^3	Inh, Abs, Ing, Con	Epil Conv, Stup, Head, Dizz, Abdom, Nau, Vomit, Insom, Agress, Conf, Drow, Lass, Anor

TABLE 1
CHEMICAL HAZARDS KNOWN OR SUSPECTED ON-SITE

CONTAMINANT	ODOR THRESHOLD	OSHA PEL[1]	TLV (ACGIH)	OSHA CEILING[2] /STEL	IDLH CONC.	ROUTES OF EXPOSURE	SYMPTOMS OF ACUTE EXPOSURE[3]
Endrin Aldehyde	1.8×10^{-2} ppm	---	---	---	---	Inh, Con	---
Endrin Ketone	---	---	---	---	---	---	---
Heptachlor	0.02 ppm	0.5 mg/m^3	0.05 mg/m^3	---	[35 mg/m^3]	Inh, Abs, Ing, Con	In animals, Trem, Conv, [Carc]
Heptachlor epoxide	0.02 ppm	---	0.05 mg/m^3	---	---	Ing, Inh	Trem, Conv, [Carc]
Hydrogen Cyanide(Hydrocyanic Acid)	0.9 mg/m^3	10 ppm (11 mg/m^3)	4.7 ppm	4.7 ppm	50 ppm	Con, Inh, Ing, Abs	Asphy & death at high levels; Weak, Head, Conf, Nau, Vomit, Incr. Rate and Depth of Respiration or Respiration Slow and Gasping

NOTES

* = Constituent found in ETPH

**=Constituent found in Acid/Base/Neutral Extractable Compounds

***=Constituent found in Volatile Organic Compounds

****=Constituent found in Leaching Lead

[1] PEL = Permissible Exposure Limit. If no PEL is available, then the NIOSH Threshold Limit Value (TLV) should be used, if available.

[2] Ceiling limit or Short Term Exposure Limit (STEL), if available. Again, the NIOSH TLV may be used if no OSHA standard exists.

[3] Abbreviations are contained on the next page

[ ] = Potential Occupational Carcinogen

ND = Not Been Determined

ABBREVIATIONS

abdom = Abdominal
abs = Absorption
aggress = Aggressiveness
agit = Agitation
anor = Anorexia
anos = Anosmia (loss of the sense of smell)
Anxi = anxiety
anem – Anemia
aspir = Aspiration
asph – asphyxia
bron = Bronchitis
bron pneu = Bronchitis pneumonitis
[carc] = Potential occupational carcinogen
Card = Cardiac arrhythmias
CNS = Central nervous system
conf = Confusion
constip = Constipation
con = Skin and/or eye contact
conv = Convulsions
corn = Corneal
cyan = Cyanosis
defat = Defatting
depres = Depressant/Depression
derm = Dermatitis
diarr = Diarrhea
dist = Disturbance
dizz = Dizziness
drow = Drowsiness
dry = Dry mouth
dysp = Dyspnea (breathing difficulty)
emphy = Emphysema
epil-conv = Epileptiform convulsions
eryth = Erythema
euph = Euphoria
fib = Fibrosis
frost = frostbite
ftg = Fatigue
flush = Flushing
GI = Gastrointestinal
head = Headache
hyperpig = Hyperpigmentation
inco = Incoordination
ing = Ingestion
inh = Inhalation
inj = Injury
insom = Insomnia
irrit = Irritation
irrty = Irritability
lac = Lacrimination (discharge of tears)
lass = Lassitude (weakness, exhaustion)
li-head = Lightheadedness
liq = Liquid
low-wgt = Weight loss
mal = Malaise (vague feeling of discomfort)
malnut = Malnutrition
methem = Methemoglobinemia
myo = Myochonic (jerks of limbs)
mg/m = milligrams/cubic meter
muc memb = Mucous membrane
mus ftg = Muscle fatigue
narco = Narcosis
nau = Nausea
ner = Nervousness
numb = Numbness
optic = Optic nerve damage (blindness)
pall = Facial pallor
parap = Paralysis
ppm = Parts per million
pares = Paresthesia
paresi = Paresis
peri neur = Peripheral neuropathy
pneu = Pneumonitis
prot = Proteinuria
pulm = Pulmonary
peri neur = Peripheral neuropathy
pneu = Pneumonia
prot = Proteinuria
pulm = Pulmonary
repro = Reproductive
resp = Respiratory
skin sen = skin sensitization
salv = Salvation
som = Somnolence (sleepiness unnatural drowsiness)
subs = Substernal (occurring beneath the sternum)
stup = Stupor
sys = System
tingle = tingle limbs
trem – Tremors
verti = Vertigo
vis dist = Visual disturbance
vomit = Vomiting
weak = Weakness

APPENDIX A

Safety and Logistics Planning Call Log

Safety and Logistics Call Log
DEC009808

HRP

Date of Call ____________________

Work Assignment Number / Task ____________________

DEC Site Name and Number ____________________

Names of Attendees (and phone #s):

HRP
- HRP PM ____________________
- HRP SSO ____________________
- HRP Other ____________________
- HRP Other ____________________
- HRP Other ____________________

Subcontractors
- Driller Contact ____________________
- Utility Survey ____________________
- Surveyor ____________________
- Construction ____________________
- Other ____________________

DEC
- DEC PM ____________________
- DEC Other ____________________

Other ____________________

Brief Description Scope of Work (Task Specific): Use additional forms for additional tasks.

Logisitics:

Date of Work: ____________________

Time to Meet: ____________________

Site Contact (phone): ____________________

Notification of Site Contact made by: ____________________

Describe any unusal site-specific conditions/logistics here (if any): ____________________

Notes below as needed:

Water Needed? Source Confirmed?	Y / N	
Electricity Needed? Source Confirmed?	Y / N	
Water Storage Needed?	Y / N	
Water Discharges? Permits Needed/Attained?	Y / N	
Air Monitoring - CAMP?	Y / N	

Will there be intrusive work? Y / N

Locations marked in the field? Y / N

NYS Code Rule 753/Dig Safe System: Ticket Number: ____________________

Confirmed that mark-out complete? Y / N

Anticipated Subsurface Conditions (Geology, Utilites, etc.): ____________________

Anticipated Depth to Groundwater: ____________________

Will NAPL/Product be Present: Y / N Describe: ____________________

Will there be any other parties entering the work zones? Describe control measures:

Lab and Equipment:

Equipment: Y / N PID IP Water Level Indicator CAMP Pumps controllers Survey Eq. GPS
Other:

Lab Analytical Required: Y / N VOCs SVOCs Metals PFAS 1,4D PCBs Pest/Herb
Other:

Media Tested: Soil Sediment Groundwater Surface Water Sub-slab[soil] Vapor Indoor Air
Notes of sample collection methods:

Bottle Order Received/ Checked? Y / N
How will samples be conveyed to lab?
Sample TAT? Standard 24 hr TAT 48 hr TAT Other:

Review Site - Specific Hazards (per Site-Specific HASP to be provided prior to all parties):

Site Constituents of Concern: (circle)

VOCs
HVOCs
AVOCs
SVOCs
PFAS
1,4-Dioxane

metals
Asbestos
Lead
Biologicals
pesticides
herbicides
PCBs
Other:_________________________

Site Setting: Urban Suburban Unoccupied
Traffic Bystanders Crime Plants Animals Vectors
Overhead Utilities Underground Utilities Large Equipment
High Voltage Flood/Tidal Limited Access
Confined Spaces

Task-Specific Chemicals and Hazards (describe):
PPE Level (circle): D C B A Modifications:
Glove types: Face covering needed? Y/ N
Other specialty PPE:

Safe to Work Alone: Y / N
Other Precautions: Y / N Describe:

COVID 19 Protocols to be Observed: Y / N

Waste Containment:

How/ where will materials be contained, labelled, stored, or disposed?

Miscellaneous:

APPENDIX B
Personnel Log

PERSONNEL LOG

Name	Representing	Date	Time In	Time Out

APPENDIX C

Supervisor's Investigation Report

INCIDENT REPORT

Section 1.0: Complete By Employee and Project Manager

(provide to Human Resources Manager)

Incident Case No. ______

Employee Name: Employee Title/Position:	Age: Sex: ☐ Female ☐ Male	Time employee began work: Date of Incident: Time of Incident:	Weather Conditions: Date of Report: Time Report Completed:
Department: Office Location: Supervisor:			

Employee Address: Street: City/Town: Zip Code: Phone Number:	Location of Incident: Address: City/Town: State:

Type of Incident:

☐ Motor Vehicle Accident or ☐ Near Miss or ☐ Injury occurred during routine work

☐ Company or ☐ Personal Vehicle?

First-Aid performed on-site? Yes / No

Other Medical Attention Provided? Yes / No

Time lost from work? Yes / No Number of Hours: or Number of Days:

If injuries occurred, list names and describe nature, degree, and body part injured: Number of injured:_____

1.

2.

3.

4.

Complete Section 3.0

WITNESS STATEMENT: WHAT HAPPENED AND WHAT WAS THE EMPLOYEE DOING BEFORE THE INCIDENT OCCURRED? WHAT WAS THE EMPLOYEE DOING WHEN THE INCIDENT OCCURRED? WHAT WAS THE EMPLOYEE DOING AFTER THE INCIDENT OCCURRED?	Describe what took place? Who was at fault for vehicle accidents, citation? Was power equipment involved, if so, describe?

WHAT WAS THE NATURE OF THE INJURY OR ILLNESS?	Tell us the body part that was affected and how it was affected – be specific Examples: strained lower back; chemical burn on hand
WHAT WAS THE ROOT CAUSE OF THE INCIDENT? List other individual involved in Section 3. COULD INCIDENT HAVE BEEN AVOIDED? HOW?	Get all the facts by studying the Job and situation involved. Question by use of WHY - WHAT – WHERE – WHEN – WHO – HOW Were there other factors (e.g., noise, ventilation, illumination, fatigue, age, medical conditions) that contributed to the accident?
WAS TRAINING FOR THE WORK ACTIVITY PROVIDED: TYPE: DATES:	WERE WARNING SIGNS OR LABELS POSTED:
WHAT SHOULD BE DONE? HOW CAN INCIDENT BE AVOIDED IN THE FUTURE?	WAS PERSONAL PROTECTIVE EQUIPMENT USED? NEEDED: AVAILABLE: CONTRIBUTED TO INJURY:
WHAT HAVE YOU DONE THUS FAR?	Take or recommend action, depending upon your authority. Follow up – was action effective?
HOW WILL THIS IMPROVE OPERATIONS?	OBJECTIVE Eliminate job hindrances

Completed by:	Reviewed by:	Date

Section 2.0: Complete By Supervisor or Human Resources Manager

Name: Role (witness, observer, injured, participant, etc.):	Address: Phone Number
Name: Role:	Address: Phone Number
Name: Role:	Address: Phone Number
Name: Role:	Address: Phone Number
Name: Role:	Address: Phone Number
Name: Role:	Address: Phone Number

Section 3.0: Corrective Actions (To be Completed by OHSM and CHSO)

Are corrective actions warranted? ☐ Yes ☐ No If so, proceed with corrective action list

Corrective Actions. List long term actions to be taken as a result of incident (use additional sheets if needed)	How was the corrective action implemented?	Target date of completion

OHSM Name:	CHSO Name:
OHSM Signature:	CHSO Signature:

End of incident report. Section 4.0 is to be completed and maintained by the Human Resources Department.

Section 4.0: Complete By Human Resources Manager

Incident Report Case No. ____________

The information on this page is considered CONFIDENTIAL and must be treated as such. This page will only be available to Human Resources Department or the employee's supervisor.

Insured Name:	Employee Hire Dates: Start at Company: Current Position:
Policy Number:	Is employee a company: Owner, Officer, Neither.
Employee Soc. Sec. No.:	Marital Status: Spouse Name:
Was Employee Pay Interrupted, or paid in full for time:	Employee Pay Period: Weekly, Bi-Weekly, Monthly, Other (specify)
Employee Compensated by hourly or salary? Wage Information: (tips, bonuses, commission)	Typical No. of hours worked per day____, hours per week____. Typical Start of day time__________, end of day time________.
Date of Stop Work: Date Returned to Work:	How often has employee visited doctor/hospital?
Doctor: Authorized by Co.: Y / N Street: City/Town: Zip Code: Phone Number: Authorized by Co.: Y / N	Hospital: Street: City/Town: Zip Code: Phone Number: Authorized by Co.: Y /N
Was the employee treated in an emergency room? ☐ Yes ☐ No	Was employee hospitalized overnight as an in-patient? ☐ Yes ☐ No If so, for how many days? _________

APPENDIX D

Daily Job Brief Record

JOB BRIEF RECORD

Person Conducting	Site Name/Address	HRP Client Name/Job #
Client Contact/Phone	HRP H&S Rep.	HRP Supervisor
Date/Time	Number Attending	Weather

Designated Competent Person: ____________________

Description of Work: ____________________

____

____

____

Attendees (use additional sheets as needed):

Name	Company	Signature

Emergency Telephone Numbers

FIRE / POLICE / AMBULANCE: 911

Hospital Name & Location: ____________________

NYSDEC Spill Line: 1-518-457-7362

National Response Center: 800-424-8802

CBYD: 800-922-4455

Health & Safety Manager: Mark Wright: 203-308-0983

HAZARDS

☐ Toxic
☐ Corrosive
☐ Flammable
☐ Combustible
☐ Reactive
☐ Path Waste
☐ Asbestos
☐ Extreme Cold/Heat
☐ Drains/Sumps
☐ Sharp Objects
☐ Drilling in Soil
☐ Lighting
☐ Slips/Trips/Falls
☐ Lead
☐ Soil Excavation
☐ Tank Excavation
☐ Trenching
☐ Floor Holes
☐ Working on/near Water
☐ Underground/Overhead Utilities
☐ Vehicle Traffic
☐ Hot Work
☐ Vac Truck
☐ Ladders
☐ Noise
☐ Lifting
☐ Powerwashing
☐ Elevated Work Area
☐ Live Electrical Circuits
☐ Pneumatic Tools
☐ Drum Handling
☐ Abrasive Blasting

PERSONAL SAFETY

☐ Supplied Air Respirator
☐ Fully Encapsulating Suit
☐ Overboots
☐ Safety Glasses
☐ Reflective Vests
☐ Hearing Protection
☐ SAR w/Egress Bottle
☐ Flash Suit
☐ Lifebelt/Lanyard
☐ Chemical Goggles
☐ Eye Wash
☐ Evacuation Plan
☐ SCBA
☐ NOMEX (flam resistant)
☐ Hardhats
☐ Face Shield
☐ Safety Shower
☐ Communications
☐ Air Purifying Respirator Cartridge: ____________
☐ Protected Coveralls, Type: ____________
☐ Outer Gloves, Type: ____________
☐ Inner Gloves, Type: ____________
☐ First Aid Kit
☐ Properly Sloped Excavation/ Trench
☐ PFD's
☐ Ventilation

FIRE SAFETY

- ☐ Fire Extinguishers
- ☐ Equipment Grounded & Bonded
- ☐ Smoking Area Designated Location: ______________________
- ☐ Fire Hose Laid Out
- ☐ Hot Work Permit
- ☐ Non-Sparking Tools
- ☐ Fire Blanket
- ☐ Eliminate Ignition Sources
- ☐ Alarm Box in Area, Location: ______________________
- ☐ Explosion-Proof Equipment
- ☐ Area Kept Wet

ISOLATE EQUIPMENT

- ☐ Establish Exclusion Zone/Traffic Cones
- ☐ Stop Transfers
- ☐ GFCIS
- ☐ Work Signs
- ☐ Caution Tape Area
- ☐ Temporary Fencing

ELECTRICAL EQUIPMENT

- ☐ LockOut/TagOut
- ☐ Equipment Grounded
- ☐ Non-Conductive Tools
- ☐ FR Suits/Coveralls

AIR MONITORING

Type of Meter: ______________________ Date last calibrated: ______________

SUBSTANCE	LEVEL B MAX.	ACTION LEVEL/LEVEL C MAX.	LEVEL D MAX.

Health & Safety Comments / Topics & Safety Rules Reviewed / Questions / Concerns:

____

____

____

____

____

____

____

Contaminants of Concern: ____

HEALTH & SAFETY SIGNATURE: ______________________________ Date: ______________

Is there a Site-Specific or Generic Health & Safety Plan available on-site? Yes ☐ No ☐

☐ HAZARD ZONES NOT APPLICABLE, GENERAL WORK AREA

Level D ☐ Modified Level D ☐ Level C ☐

Anything above Level C, foreman should use a Confined Space Permit/Form.

Note: HOT WORK requires a hot work permit and minimum 20# fire extinguisher. Foreman or HSM must record at least one contaminant of concern above. Toxic plants may be considered a COC if no chemical hazards are expected.

LEVEL C
Respirator Type: ____

Name	Zone	Time In	Time Out	Decon Type

Before performing Level C work, ALL employees must review HRP's Respiratory Protection Program - a copy of which must be on-site along with a HASP.

APPENDIX E

Equipment Calibration Log

EQUIPMENT CALIBRATION LOG

Instrument	Calibration Date	Calibrated By

APPENDIX F

Community Air Monitoring Plan

Community Air Monitoring Plan

2017 Doubleday Ave, Ballston Spa, New York

This 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 during remedial activities at the site. The CAMP is not intended for use in establishing action levels for workers respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative 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 off-site through the air.

Reliance on the CAMP should not preclude simple, common sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Depending on the nature of known or potential contaminants at the site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary.

Continuous monitoring will be required for all ground intrusive activities. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil samples. “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, continuing monitoring may be required during sampling activities.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than the background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work may continue with dust suppression techniques provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work will 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.

All readings will be recorded and be available for State (DEC and DOH) personnel to review.

VOC Monitoring, Response Levels, and Actions

VOCs will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using a photo ionization detector (PID) equipped with a 10.2 eV bulb. The PID will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of the 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.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will be shutdown.

All 15-minute readings will be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

APPENDIX G

COVID-19 Health and Safety Guidelines

COVID19
SITE SPECIFIC HASP ADDENDUM

This addendum will remain in effect until what time the CDC, NIAID, and/or Surgeon General guidance is provided that removes the heightened awareness of social distancing, hand washing, and other protocols in response to COVID-19.

NECESSARY ADDITIONAL SUPPLIES

- Hand sanitizer (minimum 60% alcohol)
- Squeeze bottles of water (if no running water at job site)
- Soap
- Disinfectant (for tools, vehicles, common areas, etc.)
- Caution tape, cones or similar to set up social distancing boundaries as needed

EMPLOYEE HEALTH PROTECTION – ZERO TOLERANCE

The following applies to both HRP employees and contracted staff working on behalf of the HRP or the client.

- ZERO TOLERANCE FOR SICK WORKERS REPORTING TO WORK. IF YOU ARE SICK, STAY HOME! IF YOU FEEL SICK, GO HOME! IF YOU SEE SOMEONE SICK, SEND THEM HOME!
- If you are exhibiting any of the symptoms below, you are to report this to your supervisor (via phone, text or email) right away, and head home from the job site or stay home if already there.

  If you notice a co-worker showing signs or complaining about such symptoms, he or she should be directed to their supervisor (via phone, text or email) and asked to leave the project site immediately.

  COVID-19 Typical Symptoms:
    - Fever
    - Cough
    - Shortness of Breath
    - Sore Throat
    - Loss of taste or smell
- Prior to starting a shift, each employee will verbally self-certify to their supervisor that they:
    - Have no signs of a fever or a measured temperature above 100.3 degrees or greater, a cough or trouble breathing within the past 24 hours.
    - Have not had “close contact” with an individual diagnosed with COVID-19. “Close contact” means living in the same household as a person who has tested positive for COVID-19, caring for a person who has tested positive for COVID-19, being within 6 feet of a person who has tested positive for COVID-19 for about 15 minutes, or coming in direct contact with secretions (e.g., sharing utensils, being coughed on) from a person who has tested positive for COVID-19, while that person was symptomatic.
    - Have not been asked to self-isolate or quarantine by their doctor or a public health official.
    - These self-certifications may be documented at the request of the site owner
- Workers that are working in a confined space or inside a closed building envelope will have to be temperature screened by a Medical Professional or designated individual. Such screening shall be performed out of public view to respect privacy and results are kept private.
- Employees exhibiting symptoms or unable to self-certify should be directed to leave the work

site and seek medical attention and applicable testing by their health care provider. They are not to return to the work site until cleared by a medical professional.

GENERAL ON-THE-JOB GUIDANCE TO PREVENT EXPOSURE & LIMIT THE TRANSMISSION OF THE VIRUS

All Job Sites

- o No touching or direct contact with other individuals, including handshaking.
- o Wash hands often with soap and water for at least 20 seconds or alternatively when soap and water are not available, use an alcohol-based hand sanitizer with at least 60% ethanol or 70% isopropanol
- o A "No Congregation" policy is in effect, individuals must implement social distancing by maintaining a minimum distance of 6-feet from all other individuals
- o Avoid face to face meetings – critical situations requiring in-person discussion must follow social distancing
- o Conduct all meetings via conference calls, if possible. Do not convene meetings of more than 10 people. Recommend use of cell phones, texting, web meeting sites and conference calls for project discussion
- o Be sure to use your own water bottle, and do not share
- o To avoid external contamination, bring food from home
- o Maintain Social Distancing separation during breaks and lunch.
- o To avoid sharing germs, please clean up after yourself. DO NOT make others responsible for moving, unpacking and packing up your personal belongings
- o If you or a family member is feeling ill, stay home!

Multi-person job sites (i.e. HRP and subcontractors, etc.)

- o Contractor and Field Offices are to be locked down to all but authorized personnel
- o Each jobsite should develop cleaning and decontamination procedures that are posted and shared (if multi-person job site). These Procedures must cover all areas including trailers, gates, equipment, vehicles, etc. and shall be posted at all entry points to the sites, and throughout the project site.
- o All individual work crew meetings/tailgate talks should be held outside and follow social distancing
- o Please keep all crews a minimum of 6' apart at all times to eliminate the potential of cross contamination
- o At each job briefing/tool box talk, employees are asked if they are experiencing any symptoms, and are sent home if they are
- o Each jobsite should have laminated COVID-19 safety guidelines and handwashing instructions (last page of this addendum)
- o All restroom facilities/porta-potties should be cleaned and handwashing stations must be provided with soap, hand sanitizer and paper towels
- o All surfaces should be cleaned at least twice a day, including desk, work stations, door handles, laptops, etc.
- o All common areas and meeting areas are to be regularly cleaned and disinfected at least once a day but preferably twice a day

- Single person job sites (just one HRP employee, no subs, vendors, etc.)
  - o It is that person's responsibility to clean and disinfect all tools and reusable supplies upon return to the office

  - Cover coughing or sneezing with a tissue, then throw the tissue in the trash and wash hands, if no tissue is available then cough into your elbow
  - Avoid touching eyes, nose, and mouth with your hands

WORK SITE RISK PREVENTION PRACTICES

- At the start of each shift, confirm with all employees that they are healthy.
- All employees will be required to wear gloves (either latex or cut resistant depending on the task at hand)
- Use of eye protection is required (Safety glasses or googles at a minimum with or without face shields).
- In work conditions where required social distancing is impossible to achieve, affected employees shall be supplied PPE including as appropriate a standard face covering, gloves, and eye protection.
- All employees shall drive to work site/parking area in a single occupant vehicle. No one should ride together in the same vehicle
- When entering a machine or vehicle which you are not sure you were the last person to enter, make sure that you wipe down the interior and door handles with disinfectant prior to entry
- In instances where it is possible, workers should maintain separation of 6' from each other per CDC guidelines.
- Multi person activities will be limited where feasible (two person lifting activities)
- Large gathering places on the site such as shacks and break areas will be eliminated and instead small break areas will be used with seating limited to ensure social distancing.
- Contact the cleaning person for your office trailer or office space and ensure they have proper COVID- 19 sanitation processes. Increase their cleaning visits to daily
- Clean all high contact surfaces a minimum of twice a day in order to minimize the spread of germs in areas that people touch frequently. This includes but is not limited to desks, laptops and vehicles

Wash Stations: All sites without ready access to an indoor bathroom or running water MUST install Wash Stations or provide other means for handwashing

- Install hand wash stations with hot water, if possible, and soap at fire hydrants or other water sources to be used for frequent handwashing for all onsite employees.
- All onsite workers must help to maintain and keep stations clean
- If a worker notices soap or towels are running low or out, immediately notify supervisors
- Garbage barrels will be placed next to the hand wash station for disposal of tissues/towels
- If no other alternative exists, bring squeeze bottles with water and soap (only authorized for single employee job sites)

Please Note: This document is not intended to replace any formalized procedures currently in place within the site specific HASP or any job related contracts.

Where this guidance does not meet or exceed the standards put forth by the state, municipality, site owner, contractor or subcontractor, everyone shall abide by the most stringent procedure.

A site-specific COVID-19 Officer (also known as the Health and Safety Officer) shall be designated for every site.

Print and post at each job site

COVID-19/ Health and Safety Officer Name: ___________________________

Phone Number: ____

Wash your hands often with soap and warm water, or use an alcohol-based hand sanitizer.

Avoid touching your eyes, nose and mouth.

Cover your mouth when you cough or sneeze. Use a tissue or your inner elbow, not your hands.

Clean things that are frequently touched (like doorknobs and countertops) with household cleaning spray or wipes.

Stay home if you are sick and avoid close contact with others.

Think ahead about how to take care of yourself and your loved ones. Visit **mass.gov/KnowPlanPrepare** for preparedness tips.

Any issue of non-compliance with these guidelines shall be a basis for pausing the work. The Health and Safety Officer will address corrective actions with the subcontractor. Any additional issues of non-conformance may be subject to action against the subcontractor's prequalification and certification status.

APPENDIX H

Safety Data Sheets
(for chemicals brought to the site)

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: Alconox

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer	**Supplier**
Alconox, Inc. 30 Glenn Street White Plains, NY 10603 1-914-948-4040	Not Applicable

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:

Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Additional information: None.

Hazard description
Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:

The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:

The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 **Chemical characterization** : None

3.2 **Description** : None

3.3 **Hazardous components (percentages by weight)**

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 **Additional Information** : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:

Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:

Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:

Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:

Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

4.2 Most important symptoms and effects, both acute and delayed

None

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

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:

Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :

Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:

Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :

Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :

Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :

Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :

Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :

Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

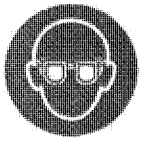
7.2 Conditions for safe storage, including any incompatibilities :

Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

8 Exposure controls/personal protection



8.1 Control parameters :

7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3.

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density**:	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or not available.

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: 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.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

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

NFPA: 1-0-0

HMIS: 1-0-0

SAFETY DATA SHEET

Version 5.2
Revision Date 02/24/2014
Print Date 11/13/2016

1. PRODUCT AND COMPANY IDENTIFICATION

1.1 Product identifiers

Product name	:	Distilled water
Product Number	:	07-6061
Brand	:	Katayama OEM Partner
REACH No.	:	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.
CAS-No.	:	7732-18-5

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

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich
3050 Spruce Street
SAINT LOUIS MO 63103
USA

Telephone : +1 800-325-5832
Fax : +1 800-325-5052

1.4 Emergency telephone number

Emergency Phone # : +1-703-527-3887 (CHEMTREC)

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Not a hazardous substance or mixture.

2.2 GHS Label elements, including precautionary statements

Not a hazardous substance or mixture.

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

3. COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

Formula	:	H2O H_2O
Molecular Weight	:	18.02 g/mol
CAS-No.	:	7732-18-5
EC-No.	:	231-791-2

No ingredients are hazardous according to OSHA criteria.
No components need to be disclosed according to the applicable regulations.

4. FIRST AID MEASURES

4.1 Description of first aid measures

If inhaled
If not breathing give artificial respiration

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
no data available

5. FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.2 Special hazards arising from the substance or mixture
no data available

5.3 Advice for firefighters
no data available

5.4 Further information
The product itself does not burn.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
For personal protection see section 8.

6.2 Environmental precautions
no data available

6.3 Methods and materials for containment and cleaning up
Wipe up with absorbent material (e.g. cloth, fleece).

6.4 Reference to other sections
For disposal see section 13.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
No special storage conditions required.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

Components with workplace control parameters
Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice.

Personal protective equipment

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

Full contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min

Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0.11 mm
Break through time: 480 min
Material tested:Dermatril® (KCL 740 / Aldrich Z677272, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Respiratory protection
No special protective equipment required.

Control of environmental exposure
Prevent product from entering drains.

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9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: liquid Colour: colourless
b)	Odour	no data available
c)	Odour Threshold	no data available
d)	pH	6.0 - 8.0 at 25 °C (77 °F)
e)	Melting point/freezing point	0.0 °C (32.0 °F)
f)	Initial boiling point and boiling range	100 °C (212 °F) - lit.
g)	Flash point	not applicable
h)	Evapouration rate	no data available
i)	Flammability (solid, gas)	no data available
j)	Upper/lower flammability or explosive limits	no data available
k)	Vapour pressure	no data available
l)	Vapour density	no data available
m)	Relative density	1.000 g/cm3 at 3.98 °C (39.16 °F)
n)	Water solubility	completely miscible
o)	Partition coefficient: n-octanol/water	no data available
p)	Auto-ignition temperature	no data available
q)	Decomposition temperature	no data available
r)	Viscosity	no data available
s)	Explosive properties	no data available
t)	Oxidizing properties	no data available

9.2 Other safety information
no data available

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10. STABILITY AND REACTIVITY

10.1 Reactivity
no data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
no data available

10.4 Conditions to avoid
no data available

10.5 Incompatible materials
no data available

10.6 Hazardous decomposition products
In the event of fire: see section 5

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11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity
no data available

Inhalation: no data available

Dermal: no data available

no data available

Skin corrosion/irritation
no data available

Serious eye damage/eye irritation
no data available

Respiratory or skin sensitisation
no data available

Germ cell mutagenicity
no data available

Carcinogenicity

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

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

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

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

Reproductive toxicity
no data available

no data available

Specific target organ toxicity - single exposure
no data available

Specific target organ toxicity - repeated exposure
no data available

Aspiration hazard
no data available

Additional Information
RTECS: ZC0110000

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

12. ECOLOGICAL INFORMATION

12.1 Toxicity
no data available

12.2 Persistence and degradability
not applicable

12.3 Bioaccumulative potential
no data available

12.4 Mobility in soil
no data available

12.5 Results of PBT and vPvB assessment
PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Other adverse effects

no data available

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Product
Taking into account local regulations the product may be disposed of as waste water after neutralisation.

14. TRANSPORT INFORMATION

DOT (US)
Not dangerous goods

IMDG
Not dangerous goods

IATA
Not dangerous goods

15. REGULATORY INFORMATION

REACH No. : A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.

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

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

SARA 311/312 Hazards
No SARA Hazards

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

Pennsylvania Right To Know Components

	CAS-No.	Revision Date
Water	7732-18-5	

New Jersey Right To Know Components

	CAS-No.	Revision Date
Water	7732-18-5	

California Prop. 65 Components

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

16. OTHER INFORMATION

HMIS Rating

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

NFPA Rating

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

Further information

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

Preparation Information

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

Version: 5.2 Revision Date: 02/24/2014 Print Date: 11/13/2016

SAFETY DATA SHEET

1. Identification

Product identifier: NITRIC ACID

Other means of identification

Synonyms:	Aqua Fortis, Azotic Acid
Product No.:	9604, V471, V231, V230, V077, 6623, 2712, 2707, 2706, 2704, H988, 5876, 5856, 5801, 5796, 1409, 9761, 9670, 9618, 9617, 9616, 9615, 9612, 9607, 9606, 9601, 9598, 9597, 5371, 20758, 20754, 20752, 20750, 9766

Recommended use and restriction on use

Recommended use: Not available.
Restrictions on use: Not known.

Details of the supplier of the safety data sheet

Manufacturer

Company Name:	Avantor Performance Materials, Inc.
Address:	3477 Corporate Parkway, Suite 200 Center Valley, PA 18034
Telephone:	Customer Service: 855-282-6867
Fax:	610-573-2610
Contact Person:	Environmental Health & Safety
E-mail:	info@avantormaterials.com

Emergency telephone number:
CHEMTREC: 1-800-424-9300 within US and Canada

2. Hazard(s) identification

Hazard Classification

Physical Hazards

Oxidizing liquids	Category 3
Corrosive to metals	Category 1

Health Hazards

Skin Corrosion/Irritation	Category 1A
Serious Eye Damage/Eye Irritation	Category 1
Specific Target Organ Toxicity - Single Exposure	Category 3

Unknown toxicity - Health

Acute toxicity, oral	65 %
Acute toxicity, dermal	65 %
Acute toxicity, inhalation, vapor	100 %
Acute toxicity, inhalation, dust or mist	100 %

Unknown toxicity - Environment

Acute hazards to the aquatic environment	65 %
Chronic hazards to the aquatic environment	65 %

Label Elements

Hazard Symbol:

Signal Word: Danger

Hazard Statement: May intensify fire; oxidizer.
May be corrosive to metals.
Causes severe skin burns and eye damage.
May cause respiratory irritation.

Precautionary Statements

Prevention: Wear protective gloves/protective clothing/eye protection/face protection. Wash hands thoroughly after handling. Keep only in original container. Keep away from heat. Keep/Store away from clothing/combustible materials. Take any precaution to avoid mixing with combustibles. Use only outdoors or in a well-ventilated area.

Response: In case of fire: Use water spray, foam, dry powder or carbon dioxide for extinction. Immediately call a POISON CENTER/doctor. IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Absorb spillage to prevent material damage.

Storage: Store locked up. Store in corrosive resistant container with a resistant inner liner. Store in a well-ventilated place. Keep container tightly closed.

Disposal: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

Other hazards which do not result in GHS classification: None.

3. Composition/information on ingredients

Mixtures

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
NITRIC ACID		7697-37-2	65 - 70%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

General information:	Get medical advice/attention if you feel unwell. Show this safety data sheet to the doctor in attendance.
Ingestion:	Call a physician or poison control center immediately. Do NOT induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.
Inhalation:	Move to fresh air. Call a physician or poison control center immediately. If breathing stops, provide artificial respiration. If breathing is difficult, give oxygen.
Skin Contact:	Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician or poison control center immediately. Wash contaminated clothing before reuse. Destroy or thoroughly clean contaminated shoes.
Eye contact:	Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Call a physician or poison control center immediately. In case of irritation from airborne exposure, move to fresh air. Get medical attention immediately.

Most important symptoms/effects, acute and delayed

Symptoms:	Causes severe skin burns and eye damage. Causes digestive tract burns. Spray mists may cause respiratory tract irritation.
Hazards:	Corrosive.

Indication of immediate medical attention and special treatment needed

Treatment:	Treat symptomatically. Symptoms may be delayed.

5. Fire-fighting measures

General Fire Hazards:	Strong oxidizer - contact with other material may cause fire.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media:	Water spray, fog, CO2, dry chemical, or regular foam.
Unsuitable extinguishing media:	None known.
Specific hazards arising from the chemical:	Oxidizing Contact with combustible material may cause fire. Fire may produce irritating, corrosive and/or toxic gases.

Special protective equipment and precautions for firefighters

Special fire fighting procedures:	Move containers from fire area if you can do so without risk. Use water spray to keep fire-exposed containers cool. Cool containers exposed to flames with water until well after the fire is out.
Special protective equipment for fire-fighters:	Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA. Self-contained breathing apparatus and full protective clothing must be worn in case of fire.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures:	Keep unauthorized personnel away. ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Use personal protective equipment. See Section 8 of the SDS for Personal Protective Equipment. Ventilate closed spaces before entering them. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
Methods and material for containment and cleaning up:	Keep combustibles (wood, paper, oil, etc.) away from spilled material. Stop leak if possible without any risk. Do not absorb in sawdust or other combustible materials. Absorb spill with vermiculite or other inert material. Collect in a non-combustible container for prompt disposal. Clean surface thoroughly to remove residual contamination. Dike far ahead of larger spill for later recovery and disposal.
Notification Procedures:	Dike for later disposal. Prevent entry into waterways, sewer, basements or confined areas. Stop the flow of material, if this is without risk. Inform authorities if large amounts are involved.
Environmental Precautions:	Do not contaminate water sources or sewer. Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling:	Keep away from combustible material. Do not get in eyes, on skin, on clothing. Wash hands thoroughly after handling. Do not eat, drink or smoke when using the product. Do not taste or swallow. Never add water to acid! Never pour water into acid/base. Dilute by slowly pouring the product into water while stirring.
Conditions for safe storage, including any incompatibilities:	Do not store in metal containers. Store away from heat and light. Keep away from combustible material. Keep containers closed when not in use. Store in a cool, dry place. Keep container in a well-ventilated place.

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	type	Exposure Limit Values		Source
NITRIC ACID	STEL	4 ppm		US. ACGIH Threshold Limit Values (2011)
	TWA	2 ppm		US. ACGIH Threshold Limit Values (2011)
	STEL	4 ppm	10 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	REL	2 ppm	5 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	PEL	2 ppm	5 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	STEL	4 ppm	10 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)
	TWA	2 ppm	5 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)

Appropriate Engineering Controls	Adequate ventilation should be provided so that exposure limits are not exceeded.

Individual protection measures, such as personal protective equipment

General information: Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. An eye wash and safety shower must be available in the immediate work area.

Eye/face protection: Wear safety glasses with side shields (or goggles) and a face shield.

Skin Protection

Hand Protection: Chemical resistant gloves

Other: Wear suitable protective clothing.

Respiratory Protection: In case of inadequate ventilation use suitable respirator. Chemical respirator with acid gas cartridge.

Hygiene measures: Provide eyewash station and safety shower. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing to remove contaminants. Discard contaminated footwear that cannot be cleaned.

9. Physical and chemical properties

Appearance

Physical state: liquid

Form: liquid

Color: Colorless to slightly yellow

Odor: Pungent

Odor threshold: No data available.

pH: 1 (6.30 g/l,)

Melting point/freezing point: -42 °C

Initial boiling point and boiling range: 122 °C

Flash Point: not applicable

Evaporation rate: No data available.

Flammability (solid, gas): No data available.

Upper/lower limit on flammability or explosive limits

Flammability limit - upper (%): No data available.

Flammability limit - lower (%): No data available.

Explosive limit - upper (%): No data available.

Explosive limit - lower (%): No data available.

Vapor pressure: 6.4 kPa

Vapor density: 2.5

Relative density: 1.41 (20 °C)

Solubility(ies)

Solubility in water: Soluble

Solubility (other): No data available.

Partition coefficient (n-octanol/water): No data available.

Auto-ignition temperature: No data available.

Decomposition temperature: No data available.

Viscosity: No data available.

10. Stability and reactivity

Reactivity:	Reacts violently with strong alkaline substances.
Chemical Stability:	Material is stable under normal conditions.
Possibility of hazardous reactions:	Hazardous polymerization does not occur. Decomposes on heating.
Conditions to avoid:	Reacts violently with strong alkaline substances. Avoid contact with strong reducing agents. Excessive heat. Contact with incompatible materials.
Incompatible Materials:	Alcohols. Reducing agents. Metals. Alkalies.
Hazardous Decomposition Products:	Nitrogen Oxides By heating and fire, corrosive vapors/gases may be formed.

11. Toxicological information

Information on likely routes of exposure

Ingestion:	May cause burns of the gastrointestinal tract if swallowed.
Inhalation:	May cause damage to mucous membranes in nose, throat, lungs and bronchial system.
Skin Contact:	Causes severe skin burns.
Eye contact:	Causes serious eye damage.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral

Product:	No data available.

Dermal

Product:	No data available.

Inhalation

Product:	No data available.
Specified substance(s):	
NITRIC ACID	LC 50 (Rat, 1 h): 7 mg/l LC 50 (Rat, 4 h): 65 ppm

Repeated dose toxicity

Product:	No data available.

Skin Corrosion/Irritation

Product:	Causes severe skin burns.

Serious Eye Damage/Eye Irritation

Product:	Causes serious eye damage.

Respiratory or Skin Sensitization

Product:	Not a skin nor a respiratory sensitizer.

Carcinogenicity

Product:	This substance has no evidence of carcinogenic properties.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogenic components identified

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogenic components identified

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified

Germ Cell Mutagenicity

In vitro

Product:	No mutagenic components identified

In vivo

Product:	No mutagenic components identified

Reproductive toxicity

Product:	No components toxic to reproduction

Specific Target Organ Toxicity - Single Exposure

Product:	Respiratory tract irritation.

Specific Target Organ Toxicity - Repeated Exposure

Product:	None known.

Aspiration Hazard

Product:	Not classified

Other effects:	None known.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product:	No data available.
Specified substance(s):	
NITRIC ACID	LC 50 (Starfish (Asterias rubens), 48 h): 100 - 330 mg/l Mortality

Aquatic Invertebrates

Product:	No data available.
Specified substance(s):	
NITRIC ACID	LC 50 (Cockle (Cerastoderma edule), 48 h): 330 - 1,000 mg/l Mortality LC 50 (Green or European shore crab (Carcinus maenas), 48 h): 180 mg/l Mortality

Chronic hazards to the aquatic environment:

Fish

Product:	No data available.

Aquatic Invertebrates

Product:	No data available.

Toxicity to Aquatic Plants

Product:	No data available.

Persistence and Degradability

Biodegradation

Product:	Expected to be readily biodegradable.

BOD/COD Ratio

Product:	No data available.

Bioaccumulative Potential

Bioconcentration Factor (BCF)

Product:	No data available on bioaccumulation.

Partition Coefficient n-octanol / water (log Kow)

Product:	No data available.

Mobility in Soil:	The product is water soluble and may spread in water systems.
Other Adverse Effects:	The product may affect the acidity (pH-factor) in water with risk of harmful effects to aquatic organisms.

13. Disposal considerations

Disposal instructions:	Discharge, treatment, or disposal may be subject to national, state, or local laws.
Contaminated Packaging:	Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN Number:	UN 2031
UN Proper Shipping Name:	Nitric acid
Transport Hazard Class(es)	
Class(es):	8, 5.1
Label(s):	8, 5.1
Packing Group:	II
Marine Pollutant:	Not a Marine Pollutant
Special precautions for user:	–

IMDG

UN Number:	UN 2031
UN Proper Shipping Name:	NITRIC ACID
Transport Hazard Class(es)	
Class(es):	8, 5.1
Label(s):	8, 5.1
EmS No.:	F-A, S-Q
Packing Group:	II
Marine Pollutant:	Not a Marine Pollutant
Special precautions for user:	–

IATA

UN Number:	UN 2031
Proper Shipping Name:	Nitric acid
Transport Hazard Class(es):	
Class(es):	8, 5.1
Label(s):	8, 5.1
Marine Pollutant:	Not a Marine Pollutant
Packing Group:	II
Special precautions for user:	–

15. Regulatory information

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

Chemical Identity	Reportable quantity
NITRIC ACID	1000 lbs.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Acute (Immediate)
Chronic (Delayed)
Fire

SARA 302 Extremely Hazardous Substance

Chemical Identity	Reportable quantity	Threshold Planning Quantity
NITRIC ACID	1000 lbs.	1000 lbs.

SARA 304 Emergency Release Notification

Chemical Identity	Reportable quantity
NITRIC ACID	1000 lbs.

SARA 311/312 Hazardous Chemical

Chemical Identity	Threshold Planning Quantity
NITRIC ACID	500lbs

SARA 313 (TRI Reporting)

Chemical Identity	Reporting threshold for other users	Reporting threshold for manufacturing and processing
NITRIC ACID	10000 lbs	25000 lbs.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

Chemical Identity	Reportable quantity
NITRIC ACID	Reportable quantity: 1000 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

Chemical Identity	Reportable quantity
NITRIC ACID	15000 lbs

US State Regulations

US. California Proposition 65

No ingredient regulated by CA Prop 65 present.

US. New Jersey Worker and Community Right-to-Know Act

Chemical Identity
NITRIC ACID

US. Massachusetts RTK - Substance List

Chemical Identity
NITRIC ACID

US. Pennsylvania RTK - Hazardous Substances

Chemical Identity
NITRIC ACID

US. Rhode Island RTK

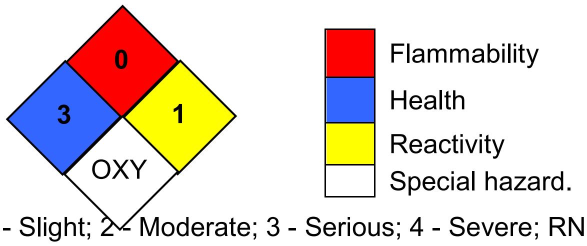
Chemical Identity
NITRIC ACID

Inventory Status:

Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
EINECS, ELINCS or NLP:	On or in compliance with the inventory
Japan (ENCS) List:	On or in compliance with the inventory
China Inv. Existing Chemical Substances:	Not in compliance with the inventory.
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	On or in compliance with the inventory
US TSCA Inventory:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Japan ISHL Listing:	Not in compliance with the inventory.
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.

16.Other information, including date of preparation or last revision

NFPA Hazard ID



Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible
OXY: Oxidizer

Issue Date:	12-06-2016
Revision Date:	No data available.
Version #:	3.1
Further Information:	No data available.

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SAFETY DATA SHEET

1. Identification

Product identifier: SODIUM BISULFATE

Other means of identification
Product No.: 7432, 3534

Recommended use and restriction on use

Recommended use: Not available.
Restrictions on use: Not known.

Manufacturer/Importer/Supplier/Distributor information

Manufacturer
Company Name: Avantor Performance Materials, Inc.
Address: 3477 Corporate Parkway, Suite 200
Center Valley, PA 18034
Telephone:
Customer Service: 855-282-6867
Fax:
Contact Person: Environmental Health & Safety
e-mail: info@avantormaterials.com

Emergency telephone number:
24 Hour Emergency: 908-859-2151

Chemtrec: 800-424-9300

2. Hazard(s) identification

Hazard classification

Health hazards

Serious eye damage/eye irritation Category 1

Label elements

Hazard symbol:

Signal word: Danger

Hazard statement: Causes serious eye damage.

Precautionary statement

Prevention: Wear eye protection/face protection.

Response: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or doctor/physician.

Other hazards which do not result in GHS classification:	None.

3. Composition/information on ingredients

Mixtures

Chemical identity	Common name and synonyms	CAS number	Content in percent (%)*
SODIUM BISULFATE (HYDRATED FORM)		10034-88-5	90 - 100%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

General information:	Get medical advice/attention if you feel unwell. Show this safety data sheet to the doctor in attendance.
Ingestion:	Rinse mouth thoroughly. Get medical attention if symptoms occur.
Inhalation:	Move to fresh air. Get medical attention if symptoms occur.
Skin contact:	Wash skin thoroughly with soap and water. Get medical attention if irritation persists after washing.
Eye contact:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Call a physician or poison control center immediately.

Most important symptoms/effects, acute and delayed

Symptoms:	Causes serious eye damage.

Indication of immediate medical attention and special treatment needed

Treatment:	Treat symptomatically.

5. Fire-fighting measures

General fire hazards:	No unusual fire or explosion hazards noted.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media:	Use fire-extinguishing media appropriate for surrounding materials.
Unsuitable extinguishing media:	Avoid water in straight hose stream; will scatter and spread fire.
Specific hazards arising from the chemical:	During fire, gases hazardous to health may be formed.

Special protective equipment and precautions for firefighters

Special fire fighting procedures:	Move containers from fire area if you can do so without risk. Use water spray to keep fire-exposed containers cool. Cool containers exposed to flames with water until well after the fire is out.

Special protective equipment for fire-fighters:	Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures:	Keep unauthorized personnel away. Use personal protective equipment. See Section 8 of the MSDS for Personal Protective Equipment.
Methods and material for containment and cleaning up:	Sweep up and place in a clearly labeled container for chemical waste. Clean surface thoroughly to remove residual contamination.
Notification Procedures:	Prevent entry into waterways, sewer, basements or confined areas. Inform authorities if large amounts are involved.
Environmental precautions:	Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling:	Use personal protective equipment as required. Avoid contact with eyes, skin, and clothing. Avoid inhalation of dust. Wash thoroughly after handling.
Conditions for safe storage, including any incompatibilities:	Keep containers tightly closed. Store in cool, dry place. Store in a well-ventilated place.

8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None of the components have assigned exposure limits.

Appropriate engineering controls	No data available.

Individual protection measures, such as personal protective equipment

General information:	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level.
Eye/face protection:	Wear safety glasses with side shields (or goggles).
Skin protection	
Hand protection:	Use suitable protective gloves if risk of skin contact.
Other:	Wear suitable protective clothing.
Respiratory protection:	In case of inadequate ventilation, use respiratory protection.
Hygiene measures:	Provide eyewash station and safety shower. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing to remove contaminants. Discard contaminated footwear that cannot be cleaned.

9. Physical and chemical properties

Appearance

- **Physical state:** Solid
- **Form:** Crystals or powder.
- **Color:** Colorless

Odor: Odorless
Odor threshold: No data available.
pH: 1.4
Melting point/freezing point: 58 °C
Initial boiling point and boiling range: No data available.
Flash Point: No data available.
Evaporation rate: No data available.
Flammability (solid, gas): No data available.
Upper/lower limit on flammability or explosive limits

- **Flammability limit - upper (%):** No data available.
- **Flammability limit - lower (%):** No data available.
- **Explosive limit - upper (%):** No data available.
- **Explosive limit - lower (%):** No data available.

Vapor pressure: No data available.
Vapor density: No data available.
Relative density: 2.1 (20 °C)
Solubility(ies)

- **Solubility in water:** 670 g/l
- **Solubility (other):** No data available.

Partition coefficient (n-octanol/water): No data available.
Auto-ignition temperature: No data available.
Decomposition temperature: No data available.
Viscosity: No data available.

Other information

- **Molecular weight:** 138.08 g/mol

10. Stability and reactivity

Reactivity: No dangerous reaction known under conditions of normal use.

Chemical stability: Material is unstable under normal conditions.

Possibility of hazardous reactions: Hazardous polymerization does not occur. The substance is hygroscopic and will absorb water by contact with the moisture in the air.

Conditions to avoid: Contact with incompatible materials. Moisture. Avoid conditions which create dust.

Incompatible materials: Strong bases.

Hazardous decomposition products: Sulfur dioxide gas may be liberated from the product.

11. Toxicological information

Information on likely routes of exposure

- **Ingestion:** May cause irritation of the gastrointestinal tract.

Inhalation:	May cause irritation to the respiratory system.
Skin contact:	May cause irritation.
Eye contact:	Causes serious eye damage.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral

Product:	No data available.

Dermal

Product:	No data available.

Inhalation

Product:	No data available.

Repeated dose toxicity

Product:	No data available.

Skin corrosion/irritation

Product:	May cause skin irritation.

Serious eye damage/eye irritation

Product:	Causes serious eye damage.

Respiratory or skin sensitization

Product:	Not a skin sensitizer.

Carcinogenicity

Product:	This substance has no evidence of carcinogenic properties.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:
No carcinogenic components identified

US. National Toxicology Program (NTP) Report on Carcinogens:
No carcinogenic components identified

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified

Germ cell mutagenicity

In vitro

Product:	No mutagenic components identified

In vivo

Product:	No mutagenic components identified

Reproductive toxicity

Product:	No components toxic to reproduction

Specific target organ toxicity - single exposure

Product:	No data available.

Specific target organ toxicity - repeated exposure

Product:	No data available.

Aspiration hazard

Product:	Not classified

Other effects:	None known.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product:	No data available.

Aquatic invertebrates

Product:	No data available.

Chronic hazards to the aquatic environment:

Fish

Product:	No data available.

Aquatic invertebrates

Product:	No data available.

Toxicity to Aquatic Plants

Product:	No data available.

Persistence and degradability

Biodegradation

Product:	There are no data on the degradability of this product.

BOD/COD ratio

Product:	No data available.

Bioaccumulative potential

Bioconcentration factor (BCF)

Product:	No data available on bioaccumulation.

Partition coefficient n-octanol / water (log Kow)

Product:	No data available.

Mobility in soil:	The product is water soluble and may spread in water systems.
Other adverse effects:	The product components are not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

13. Disposal considerations

Disposal instructions:	Discharge, treatment, or disposal may be subject to national, state, or local laws.
Contaminated packaging:	Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number:	UN 3260
UN proper shipping name:	Corrosive solid, acidic, inorganic, n.o.s.(SODIUM BISULFATE)
Transport hazard class(es)	
Class(es):	8
Label(s):	8
Packing group:	III
Marine Pollutant:	No

IMDG

UN number:	UN 3260
UN proper shipping name:	CORROSIVE SOLID, ACIDIC, INORGANIC, N.O.S.(SODIUM BISULFATE)
Transport hazard class(es)	
Class(es):	8
Label(s):	8
EmS No.:	F-A, S-B
Packing group:	III
Marine Pollutant:	No

IATA

UN number:	UN 3260
Proper Shipping Name:	Corrosive solid, acidic, inorganic, n.o.s.(SODIUM BISULFATE)
Transport hazard class(es):	
Class(es):	8
Label(s):	8
Marine Pollutant:	No
Packing group:	III

15. Regulatory information

US federal regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

None present or none present in regulated quantities.

Superfund amendments and reauthorization act of 1986 (SARA)

Hazard categories

☒ Acute (Immediate) ☐ Chronic (Delayed) ☐ Fire ☐ Reactive ☐ Pressure Generating

SARA 302 Extremely hazardous substance

None present or none present in regulated quantities.

SARA 304 Emergency release notification

None present or none present in regulated quantities.

SARA 311/312 Hazardous chemical

Chemical identity	Threshold Planning Quantity

SARA 313 (TRI reporting)

None present or none present in regulated quantities.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

None present or none present in regulated quantities.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

None present or none present in regulated quantities.

US state regulations

US. California Proposition 65

No ingredient regulated by CA Prop 65 present.

US. New Jersey Worker and Community Right-to-Know Act

No ingredient regulated by NJ Right-to-Know Law present.

US. Massachusetts RTK - Substance List

No ingredient regulated by MA Right-to-Know Law present.

US. Pennsylvania RTK - Hazardous Substances

No ingredient regulated by PA Right-to-Know Law present.

US. Rhode Island RTK

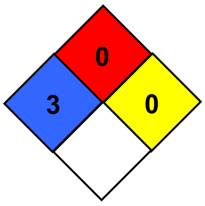
No ingredient regulated by RI Right-to-Know Law present.

Inventory Status:

Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
EINECS, ELINCS or NLP:	On or in compliance with the inventory
Japan (ENCS) List:	Not in compliance with the inventory.
China Inv. Existing Chemical Substances:	On or in compliance with the inventory
Korea Existing Chemicals Inv. (KECI):	Not in compliance with the inventory.
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	On or in compliance with the inventory
US TSCA Inventory:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Japan ISHL Listing:	Not in compliance with the inventory.
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.

16.Other information, including date of preparation or last revision

NFPA Hazard ID



🟥 Flammability
🟦 Health
🟨 Reactivity
⬜ Special hazard.

Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe

Issue date: 05-16-2014

Revision date: No data available.

Version #: 1.0

Further information: No data available.

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SAFETY DATA SHEET

1. Identification

Product identifier: Sulfuric Acid

Other means of identification

Product No.: 9661, 3780, 9704, 9682, V648, V225, V186, V008, 6902, 2900, 2879, 2878, 2877, 2874, 6163, H996, H976, 5859, 2876, 5815, 5802, 9691, 9690, 9684, 9681, 9675, 9674, 9673, 9671, 5557, 5374, 21208, 21201, 9686

Recommended use and restriction on use

Recommended use: Not available.
Restrictions on use: Not known.

Details of the supplier of the safety data sheet

Manufacturer

Company Name: Avantor Performance Materials, Inc.
Address: 3477 Corporate Parkway, Suite 200
Center Valley, PA 18034

Telephone: Customer Service: 855-282-6867

Fax: 610-573-2610
Contact Person: Environmental Health & Safety
E-mail: info@avantormaterials.com

Emergency telephone number:
CHEMTREC: 1-800-424-9300 within US and Canada

2. Hazard(s) identification

Hazard Classification

Physical Hazards

Corrosive to metals	Category 1

Health Hazards

Skin Corrosion/Irritation	Category 1
Serious Eye Damage/Eye Irritation	Category 1
Carcinogenicity	Category 1A
Specific Target Organ Toxicity - Single Exposure	Category 3

Environmental Hazards

Acute hazards to the aquatic environment	Category 3

Label Elements

Hazard Symbol:

Signal Word: Danger

Hazard Statement:
May be corrosive to metals.
Causes severe skin burns and eye damage.
May cause respiratory irritation.
May cause cancer if inhaled.
Harmful to aquatic life.

Precautionary Statements

Prevention: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Keep only in original container. Wash thoroughly after handling. Do not breathe dust/fume/gas/mist/vapors/spray. Use only outdoors or in a well-ventilated area. Wear protective gloves/protective clothing/eye protection/face protection.

Response: IF exposed or concerned: Get medical advice/attention. Absorb spillage to prevent material damage. Immediately call a POISON CENTER or doctor/physician. IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower. Wash contaminated clothing before reuse. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. IF INHALED: Remove person to fresh air and keep comfortable for breathing.

Storage: Store locked up. Store in corrosive resistant container with a resistant inner liner. Store in a well-ventilated place. Keep container tightly closed.

Disposal: Dispose of contents/container to an appropriate treatment and disposal facility in accordance with applicable laws and regulations, and product characteristics at time of disposal.

Other hazards which do not result in GHS classification: None.

3. Composition/information on ingredients

Substances

Chemical Identity	Common name and synonyms	CAS number	Content in percent (%)*
SULFURIC ACID		7664-93-9	90 - 100%

* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

General information: Get medical advice/attention if you feel unwell. Show this safety data sheet to the doctor in attendance.

Ingestion: Call a physician or poison control center immediately. Do NOT induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs.

Inhalation:	Move to fresh air. Call a physician or poison control center immediately. Apply artificial respiration if victim is not breathing If breathing is difficult, give oxygen.
Skin Contact:	Immediately flush with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician or poison control center immediately. Wash contaminated clothing before reuse. Destroy or thoroughly clean contaminated shoes.
Eye contact:	Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Call a physician or poison control center immediately. In case of irritation from airborne exposure, move to fresh air. Get medical attention immediately.

Most important symptoms/effects, acute and delayed

Symptoms:	Corrosive to skin and eyes.

Indication of immediate medical attention and special treatment needed

Treatment:	Treat symptomatically. Symptoms may be delayed.

5. Fire-fighting measures

General Fire Hazards:	No unusual fire or explosion hazards noted. In case of fire and/or explosion do not breathe fumes.

Suitable (and unsuitable) extinguishing media

Suitable extinguishing media:	Foam, carbon dioxide or dry powder.
Unsuitable extinguishing media:	Do not use water as an extinguisher.
Specific hazards arising from the chemical:	Fire may produce irritating, corrosive and/or toxic gases.

Special protective equipment and precautions for firefighters

Special fire fighting procedures:	Move containers from fire area if you can do so without risk. Fight fire from a protected location. Use water SPRAY only to cool containers! Do not put water on leaked material. Cool containers exposed to flames with water until well after the fire is out.
Special protective equipment for fire-fighters:	Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures:	Keep unauthorized personnel away. Keep upwind. Use personal protective equipment. See Section 8 of the SDS for Personal Protective Equipment. Ventilate closed spaces before entering them. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing.
Methods and material for containment and cleaning up:	Neutralize spill area and washings with soda ash or lime. Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Clean surface thoroughly to remove residual contamination. Dike far ahead of larger spill for later recovery and disposal.

Notification Procedures:	Dike for later disposal. Prevent entry into waterways, sewer, basements or confined areas. Stop the flow of material, if this is without risk. Inform authorities if large amounts are involved.
Environmental Precautions:	Do not contaminate water sources or sewer. Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling:	Do not get in eyes, on skin, on clothing. Do not taste or swallow. Wash hands thoroughly after handling. Do not eat, drink or smoke when using the product. Use caution when adding this material to water. Add material slowly when mixing with water. Do not add water to the material; instead, add the material to the water. Do not handle until all safety precautions have been read and understood. Obtain special instructions before use. Use personal protective equipment as required.
Conditions for safe storage, including any incompatibilities:	Do not store in metal containers. Keep in a cool, well-ventilated place. Keep container tightly closed. Store in a dry place.

8. Exposure controls/personal protection

Control Parameters

Occupational Exposure Limits

Chemical Identity	type	Exposure Limit Values	Source
SULFURIC ACID - Thoracic fraction.	TWA	0.2 mg/m3	US. ACGIH Threshold Limit Values (2011)
SULFURIC ACID	REL	1 mg/m3	US. NIOSH: Pocket Guide to Chemical Hazards (2010)
	PEL	1 mg/m3	US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000) (02 2006)
	TWA	1 mg/m3	US. OSHA Table Z-1-A (29 CFR 1910.1000) (1989)

Appropriate Engineering Controls	No data available.

Individual protection measures, such as personal protective equipment

General information:	Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. An eye wash and safety shower must be available in the immediate work area.
Eye/face protection:	Wear safety glasses with side shields (or goggles) and a face shield.
Skin Protection	
Hand Protection:	Chemical resistant gloves
Other:	Wear suitable protective clothing.
Respiratory Protection:	In case of inadequate ventilation use suitable respirator. Chemical respirator with acid gas cartridge.

Hygiene measures: Provide eyewash station and safety shower. Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing to remove contaminants. Discard contaminated footwear that cannot be cleaned.

9. Physical and chemical properties

Appearance

Physical state: liquid
Form: liquid
Color: Colorless
Odor: Odorless
Odor threshold: No data available.
pH: 0.3 (1 N aqueous solution)
Melting point/freezing point: 3 °C
Initial boiling point and boiling range: 337 °C
Flash Point: not applicable
Evaporation rate: No data available.
Flammability (solid, gas): No data available.
Upper/lower limit on flammability or explosive limits
Flammability limit - upper (%): No data available.
Flammability limit - lower (%): No data available.
Explosive limit - upper (%): No data available.
Explosive limit - lower (%): No data available.
Vapor pressure: No data available.
Vapor density: No data available.
Relative density: 1.84 (20 °C)
Solubility(ies)
Solubility in water: Miscible with water.
Solubility (other): No data available.
Partition coefficient (n-octanol/water): No data available.
Auto-ignition temperature: No data available.
Decomposition temperature: No data available.
Viscosity: No data available.

10. Stability and reactivity

Reactivity: Reacts violently with strong alkaline substances.

Chemical Stability: Material is stable under normal conditions.

Possibility of hazardous reactions: Hazardous polymerization does not occur. Material reacts with water.

Conditions to avoid: Moisture. Heat. Contact with incompatible materials.

Incompatible Materials: Water. Cyanides. Strong oxidizing agents. Strong reducing agents. Metals. Halogens. Organic compounds. Potassium.

Hazardous Decomposition Products: Oxides of sulfur.

11. Toxicological information

Information on likely routes of exposure

Ingestion: May cause burns of the gastrointestinal tract if swallowed.

Inhalation: May cause damage to mucous membranes in nose, throat, lungs and bronchial system.

Skin Contact: Causes severe skin burns.

Eye contact: Causes serious eye damage.

Information on toxicological effects

Acute toxicity (list all possible routes of exposure)

Oral
Product: No data available.

Dermal
Product: No data available.

Inhalation
Product: No data available.

Specified substance(s):
SULFURIC ACID LC 50 (Guinea pig, 8 h): 0.03 mg/l
LC 50 (Rat, 4 h): 0.375 mg/l

Repeated dose toxicity
Product: No data available.

Skin Corrosion/Irritation
Product: Causes severe skin burns.

Serious Eye Damage/Eye Irritation
Product: Causes serious eye damage.

Respiratory or Skin Sensitization
Product: Not a skin sensitizer.

Carcinogenicity
Product: May cause cancer.

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans:

SULFURIC ACID Overall evaluation: 1. Carcinogenic to humans.

US. National Toxicology Program (NTP) Report on Carcinogens:
SULFURIC ACID Known To Be Human Carcinogen.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050):
No carcinogenic components identified

Germ Cell Mutagenicity

In vitro
Product: No mutagenic components identified

In vivo
Product: No mutagenic components identified

Reproductive toxicity
Product: No components toxic to reproduction

Specific Target Organ Toxicity - Single Exposure

Product:	Respiratory tract irritation.

Specific Target Organ Toxicity - Repeated Exposure

Product:	None known.

Aspiration Hazard

Product:	Not classified

Other effects:	No data available.

12. Ecological information

Ecotoxicity:

Acute hazards to the aquatic environment:

Fish

Product:	No data available.
Specified substance(s):	
SULFURIC ACID	LC 50 (Goldfish (Carassius auratus), 96 h): 17 mg/l Mortality LC 50 (Starry, european flounder (Platichthys flesus), 48 h): 100 - 330 mg/l Mortality LC 50 (Western mosquitofish (Gambusia affinis), 96 h): 42 mg/l Mortality

Aquatic Invertebrates

Product:	No data available.
Specified substance(s):	
SULFURIC ACID	LC 50 (Common shrimp, sand shrimp (Crangon crangon), 48 h): 70 - 80 mg/l Mortality LC 50 (Aesop shrimp (Pandalus montagui), 48 h): 42.5 mg/l Mortality LC 50 (Cockle (Cerastoderma edule), 48 h): 200 - 500 mg/l Mortality

Chronic hazards to the aquatic environment:

Fish

Product:	No data available.

Aquatic Invertebrates

Product:	No data available.

Toxicity to Aquatic Plants

Product:	No data available.

Persistence and Degradability

Biodegradation

Product:	There are no data on the degradability of this product.

BOD/COD Ratio

Product:	No data available.

Bioaccumulative Potential

Bioconcentration Factor (BCF)

Product:	No data available on bioaccumulation.

Partition Coefficient n-octanol / water (log Kow)

Product:	No data available.

Mobility in Soil:	The product is water soluble and may spread in water systems.
Other Adverse Effects:	The product contains a substance which is harmful to aquatic organisms. The product may affect the acidity (pH-factor) in water with risk of harmful effects to aquatic organisms.

13. Disposal considerations

Disposal instructions:	Discharge, treatment, or disposal may be subject to national, state, or local laws.
Contaminated Packaging:	Since emptied containers retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN Number:	UN 1830
UN Proper Shipping Name:	Sulfuric acid
Transport Hazard Class(es)	
Class(es):	8
Label(s):	8
Packing Group:	II
Marine Pollutant:	Not a Marine Pollutant
Special precautions for user:	–

IMDG

UN Number:	UN 1830
UN Proper Shipping Name:	SULPHURIC ACID (WITH MORE THAN 51% ACID)
Transport Hazard Class(es)	
Class(es):	8
Label(s):	8
EmS No.:	F-A, S-B
Packing Group:	II
Marine Pollutant:	Not a Marine Pollutant
Special precautions for user:	–

IATA

UN Number:	UN 1830
Proper Shipping Name:	Sulphuric acid
Transport Hazard Class(es):	
Class(es):	8
Label(s):	8
Marine Pollutant:	Not a Marine Pollutant
Packing Group:	II
Special precautions for user:	–

15. Regulatory information

US Federal Regulations

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

None present or none present in regulated quantities.

CERCLA Hazardous Substance List (40 CFR 302.4):

Chemical Identity	Reportable quantity
SULFURIC ACID	1000 lbs.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Acute (Immediate)
Chronic (Delayed)

SARA 302 Extremely Hazardous Substance

Chemical Identity	Reportable quantity	Threshold Planning Quantity
SULFURIC ACID	1000 lbs.	1000 lbs.

SARA 304 Emergency Release Notification

Chemical Identity	Reportable quantity
SULFURIC ACID	1000 lbs.

SARA 311/312 Hazardous Chemical

Chemical Identity	Threshold Planning Quantity
SULFURIC ACID	500lbs

SARA 313 (TRI Reporting)

Chemical Identity	Reporting threshold for other users	Reporting threshold for manufacturing and processing
SULFURIC ACID	10000 lbs	25000 lbs.

Clean Water Act Section 311 Hazardous Substances (40 CFR 117.3)

Chemical Identity	Reportable quantity
SULFURIC ACID	Reportable quantity: 1000 lbs.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130):

Chemical Identity	Reportable quantity
SULFURIC ACID	10000 lbs

US State Regulations

US. California Proposition 65

SULFURIC ACID	Carcinogenic.

US. New Jersey Worker and Community Right-to-Know Act

Chemical Identity
SULFURIC ACID

US. Massachusetts RTK - Substance List

Chemical Identity
SULFURIC ACID

US. Pennsylvania RTK - Hazardous Substances

Chemical Identity
SULFURIC ACID

US. Rhode Island RTK

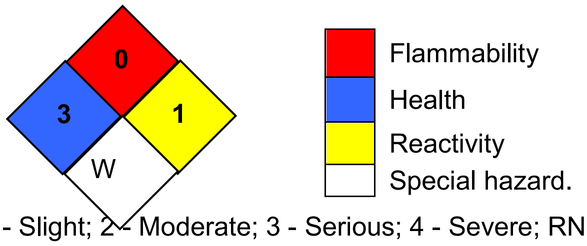
Chemical Identity
SULFURIC ACID

Inventory Status:

Australia AICS:	On or in compliance with the inventory
Canada DSL Inventory List:	On or in compliance with the inventory
EU EINECS List:	On or in compliance with the inventory
EU ELINCS List:	Not in compliance with the inventory.
Japan (ENCS) List:	On or in compliance with the inventory
EU No Longer Polymers List:	Not in compliance with the inventory.
China Inv. Existing Chemical Substances:	On or in compliance with the inventory
Korea Existing Chemicals Inv. (KECI):	On or in compliance with the inventory
Canada NDSL Inventory:	Not in compliance with the inventory.
Philippines PICCS:	On or in compliance with the inventory
US TSCA Inventory:	On or in compliance with the inventory
New Zealand Inventory of Chemicals:	On or in compliance with the inventory
Switzerland Consolidated Inventory:	Not in compliance with the inventory.
Japan ISHL Listing:	Not in compliance with the inventory.
Japan Pharmacopoeia Listing:	Not in compliance with the inventory.

16.Other information, including date of preparation or last revision

NFPA Hazard ID



Hazard rating: 0 - Minimal; 1 - Slight; 2 - Moderate; 3 - Serious; 4 - Severe; RNP - Rating not possible
W: Water-reactive

Issue Date:	12-07-2016
Revision Date:	No data available.
Version #:	2.1
Further Information:	No data available.

Disclaimer:

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APPENDIX C

NYSDEC-Approved Generic Quality Assurance Project Plan

MOVE YOUR ENVIRONMENT FORWARD

GENERIC QUALITY ASSURANCE PROJECT PLAN FOR WORK ASSIGNMENTS

Prepared For:

New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233
Contract No. D009808

Prepared By:

HRP Associates, Inc.
1 Fairfield Square, Suite 110
Clifton Park, NY 12065

Issued On: August 8, 2019

CERTIFICATION

This Generic Quality Assurance Project Plan (QAPP) has been prepared under the supervision of, and has been reviewed by, the HRP Contract Quality Assurance Officer and the HRP Contract Manager.

HRP Contract Quality Assurance Officer: Gail L. Batchelder

Gail L. Batchelder, Ph.D., P.G., L.E.P.

HRP Contract Manager:

Thomas S. Seguljic, P.E., P.G.

LIST OF REVISIONS

Date	Summary of Changes	Approval
12/2008	Original document preparation	Jeffrey R. Sotek
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

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1.0 PURPOSE AND OBJECTIVES

1.1 Purpose

This Generic Quality Assurance Project Plan (QAPP) has been prepared as a generic companion document to accompany site-specific Work Plans and Field Activity Plans prepared for each standby subcontract Work Assignment issued to HRP Associates, Inc. (HRP) by the New York State Department of Environmental Conservation (NYSDEC) under Standby Contract No. D009808. The principal purpose of this document is to specify quality assurance/quality control (QA/QC) procedures for the collection, analysis, and evaluation of data that will be legally and scientifically defensible. A project-specific QAPP, provided as an appendix to each project-specific Work Plan, will supplement this generic document by providing QAPP information that is specific to each site.

1.2 Quality Assurance Project Plan Objectives

The QAPP provides general information related to QA/QC procedures associated with the collection and analysis of samples of environmental media and includes specific representative standard operating procedures (SOPs) applicable to sample handling and field instrumentation use. Descriptions of field activities and SOPs associated with sample collection and field data acquisition associated with an analytical sampling program will be provided in detail in each project-specific Work Plan and the accompanying project-specific Field Activities Plan. Information provided in this generic QAPP includes definitions and generic goals for data quality and required types and quantities of QA/QC samples. The procedures address field documentation; sample handling, custody, and shipping; instrument calibration and maintenance; auditing; data reduction, validation, and reporting; corrective action requirements; and QA/QC reporting specific to the analyses performed by the laboratories that are used for analysis of environmental media collected under Standby Contract No. D009808. Representative laboratory information is provided, since the specific laboratory used will be selected in association with each Work Assignment.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

Each Work Assignment will be managed through an organized effort of scientific and engineering personnel and technical resources. These efforts will employ pre-approved field procedures, sampling techniques, and analytical methods to accomplish the project objectives. Effective program organization and management will permit fulfillment of these requirements by maintaining control over these activities.

2.1 Overall Project Organization and Responsibilities

The overall organizational and management plan for each Work Assignment will be presented in the project-specific Work Plan, which will include an organizational chart that illustrates the project organization and individual roles for personnel tasked with implementing the Work Plan. A Representative Organization Chart is provided with this Generic QAPP as Figure 1. The responsibilities of key project personnel are described below.

The technical management of the Work Assignments will be accomplished by the Contract Manager and the designated Project Manager and an assigned project team. Additional individuals will be made available, if warranted. The Project Manager will be responsible for developing and managing activities associated with the Work Assignment and will coordinate and direct activities identified in the project-specific Work Plan to ensure that those activities are performed in accordance with the project-specific QAPP, Work Plan, and NYSDEC requirements for the work that is performed. The Contract Manager will be responsible for overall completion of the Work Assignment in accordance with all contract requirements and Work Assignments elements and protocols.

The responsibilities of the Contract Quality Assurance (QA) Officer will include working directly with the NYSDEC Project Manager and HRP Project Manager to develop project-specific Data Quality Objectives (DQOs) for each Work Assignment and to address any project-specific changes to the generic QAPP. To maintain objectivity with respect to QA/QC auditing or decision-making, the Contract QA Officer will not be involved in the actual collection of samples and will not serve in any capacity on the project that would involve project productivity or profitability. The Contract QA Officer will act as an HRP liaison with the third-party data validator and work closely with the HRP Project Manager in QA/QC-related discussions or resolving issues with the analytical laboratory.

To facilitate adherence to the project-specific QAPP, Work Plan, and Field Activities Plan with respect to QA/QC, each Work Assignment will have an assigned Project QA Officer (generally the Contract QA Officer) to provide guidance on technical matters and review technical documents relating to the individual Work Assignment. The designated Project QA Officer will work closely with the HRP Project Manager to assess the effectiveness of the QA/QC program and recommend modifications when applicable.

The Project or Contract QA/QC Officer may delegate technical guidance or specific QA/QC activities to specially trained individuals under his/her direction. Such activities could include conducting field audits to ensure that activities performed under each Work Assignment meet technical and QA requirements as specified in the applicable project-specific documents, such as the QAPP, Work Plan, and Field Activities Plan. The Project QA Officer might also delegate preparation of project-specific data usability summary reports (DUSRs), which would subsequently be reviewed by Project QA Officer and the Contract QA Officer, depending on the project-specific requirements and the complexity of the issues identified.

HRP's Program Health and Safety Officers for each office location are also an integral part of the project implementation teams. These individuals will be responsible for the development, final technical review, and approval of the Generic Health and Safety Plan and project-specific Health and Safety Plans. In addition, they will provide authorization, if warranted, to modify personal protective equipment requirements based on field conditions. They will also provide final review of all health and safety monitoring records and personal protective equipment changes to ensure compliance with the provisions of the Health and Safety Plans.

2.2 Responsibilities for Laboratory Interaction

The HRP Project Manager or his/her designee will be responsible for directing laboratories selected for a specific Work Assignment to perform chemical analyses of environmental samples in accordance with the project-specific Work Plan. The HRP Contract QA Officer is responsible for 1) confirming that the selected laboratory is capable of providing the necessary range of analytical services in a manner that is consistent with the most recent version of the New York State Department of Environmental Conservation (NYSDEC) Analytical Service Protocol (ASP) and current United Stated Environmental Protection Agency (EPA) protocols and 2) ensuring that the selected laboratory has maintained their certification by the New York State Department of Health Environmental Laboratory Approval Program (ELAP) throughout the course of a Work Assignment.

A Laboratory Project Manager (designated by the Laboratory) will serve as the liaison between the laboratory staff and the HRP Project Manager for the Work Assignment. The laboratory is responsible for following their internal protocols for conducting QA/QC reviews of all data before those data are released to HRP, and it is the responsibility of the Laboratory Project Manager to contact the HRP Project Manager with any sample discrepancies or data concerns. The HRP Project Manager will involve the HRP Project QA Officer, as appropriate, based on the nature of the issue(s) identified.

The HRP Project QA Officer, in coordination with the HRP Project Manager, will be responsible for ensuring that laboratory QA/QC reports are provided to HRP and NYSDEC as electronic data deliverables consistent with NYSDEC requirements and electronic submission protocols, as well as in a hardcopy (such as a PDF) format. Any necessary corrective actions will be reported by the Laboratory Project Manager to the HRP Project Manager along with the QA/QC reports. The HRP Project Manager (or his/her designee), HRP QA Officer, or NYSDEC personnel may contact the laboratory directly to discuss QA concerns.

3.0 QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES FOR DATA MANAGEMENT

3.1 Introduction

This section discusses QA objectives for the environmental investigation activities at the Site. QA objectives are the requirements specifying the quality of the environmental data needed to support the decision-making process. The uncertainty must be maintained at levels that will allow the resultant data to be used for its intended purposes.

Data collected during the Work Assignments will include field measurements and laboratory analytical data. This section reviews the various types of data anticipated, and presents QA/QC objectives for data collected in conjunction with the Work Assignments.

3.2 Data Quality Objectives

Data Quality Objectives are qualitative and quantitative statements, which specify the quality of data required to support decisions. DQOs are developed to achieve the level of data quality required for anticipated data use. DQOs are implemented so that, for each task, the data are legally and scientifically defensible. The development of DQOs for a specific site takes into account a number of project-specific considerations, including: project objectives, types of data to be collected, intended use of the data, and data collection methods. These factors are used to evaluate whether the quality and quantity of data are adequate for its intended use. Sampling protocols have been developed and sampling documentation and handling procedures have been identified to result in the required data quality.

DQOs are established prior to data collection and are not considered a separate deliverable. Rather, the DQO development process is integrated with the conceptual site modeling and project planning processes, and the results are incorporated into the project-specific QAPP for the specific site location and Work Assignment. DQOs will be specified for each planned data collection activity. The DQO process results in an effective plan, which details the chosen sampling and analysis options, and the statements of confidence in decisions made during the corrective action process. Confidence statements are possible through the application of statistical techniques to the data and reference to the conceptual model that has been developed for the site.

3.3 Laboratory Quality Assurance Objectives

The fundamental mechanisms that will be employed to achieve these quality goals in laboratory analyses can be categorized as prevention, assessment, and correction. These include:

- Prevention of defects in the quality through planning and design; documented instructions and procedures; and careful selection of skilled, qualified personnel.
- Quality assessment through a program of regular audits and inspections to supplement continual informal review.
- Permanent correction of conditions adverse to quality through a closed-loop corrective action system.

Overall compliance with laboratory QC procedures will be evaluated against the criteria specified for each method. Deviations will be reported in the narrative, which contains comments or problems encountered during fractional analyses of the samples. The narrative includes the laboratory's assessment of the impact on data usability and will address QC issues related to the following:

- *Laboratory Method Performance* - QC criteria for method performance must be met for target analytes for data to be reported. These criteria generally apply to such information as instrument tune, calibration, method blanks, surrogates, and laboratory control samples.
- *Sample Matrix Effects* - QC samples are analyzed to determine measurement bias due to the sample matrix, and may include surrogates, matrix spikes, matrix spike duplicates, and laboratory duplicates. If criteria are not met, matrix interferences are confirmed either by reanalysis or by inspection of the laboratory control sample results to verify that laboratory method performance is in control. Data are reported with appropriate qualifiers or discussion.

3.4 Field Parameters and Quality Assurance Objectives

Water-quality parameters, specifically pH, conductivity, dissolved oxygen and/or oxidation/reduction potential, temperature, and turbidity (at a minimum) will be measured to provide general surface water and groundwater quality information. These parameters will also be monitored for stability during purging of groundwater monitoring wells. HRP's standard operating procedures (SOP) for field screening will be followed during field screening activities. This SOP can be found in **Appendix A**. Field methods used to measure these specific parameters will be described in detail in each of the project-specific Work Plans and Field Activity Plans.

Field screening of soil samples using a photoionization detector will be performed to assess the presence and relative concentrations of volatile organic vapors. The method for quantification of volatile organic compounds (VOCs) in soil using headspace measurement, as well as operational protocols of the photoionization detector, will be presented in the site-specific Work Plan and Field Activity Plan for each Work Assignment.

Soil vapor, indoor/outdoor air, and soil/sediment sampling locations and monitoring wells will be surveyed with the accuracy and precision requirements discussed in the project-specific Field Activity Plans. Ground surface and top-of-casing elevations for each of the newly installed monitoring wells will be measured to the nearest 0.01 foot as referenced to the North American Vertical Datum of 1988.

For field QA/QC data, specific QA objectives for each project will be determined by the HRP Project Manager in coordination with the NYSDEC Project Manager. Field QA/QC data will be maintained collected for descriptive purposes and data variability and to assist in decision-making during the performance of field activities, particularly when a dynamic work plan approach is part of the overall project work plan. The Project Manager and Project QA Officer will be responsible for reviewing and evaluating the field QC data for several purposes, including 1) recognizing whether the data collected is in accordance with project-specific DQOs and is consistent with the conceptual site model for the project and 2) recognizing anomalous or unexpected field conditions, and whether such conditions might indicate whether changes to the existing Work Plan might be necessary in a timely manner, and 3) assessing how field QC data might affect the evaluation of data usability.

Similar samples will be collected using consistent sampling methods, analyzed using consistent analytical procedures, and reported in conventional units (e.g., µg/L, µg/kg, and µg/m^3 for analytical results). Consistency in such elements is important to provide a high degree of comparability for data collected throughout the project.

3.5 Detection and Quantitation Levels

In addition, analytical sensitivity is an important component of data quality, and is evaluated using analyte detection and quantitation levels.

3.5.1 Detection Limits

A detection limit has been defined by the Committee on Environmental Improvement of the American Chemical Society (Anal. Chem. 55:2210-2218 [1983]) as "the lowest concentration that can be determined to be statistically different from a blank." Various methods are available for determining detection limits, most of which are based on the standard deviation of measurements in the region near the blank responses. The following detection limits are determined routinely in the laboratory.

Instrument Detection Limits (IDLs) are determined using the protocols given in the inorganic and organic statements of work for the EPA Contract Laboratory Program (CLP). A standard deviation is calculated from replicate measurements of a low-level standard and multiplied by 3 to give the IDL. IDLs are used as an index of instrument performance that does not include sample effects and, therefore, represent the lowest detection limit achievable. IDLs can vary between instruments of the same type and can change when re-determined.

Method Detection Limits (MDLs) are determined using the EPA procedure published in 40 Code of Federal Regulations 136 **Appendix B**. The MDL is defined as "the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte." This procedure requires that "sample processing steps of the analytical method be included in the determination of the method detection limit." Therefore, the sample matrix and sample preparation process, as well as the analytical instrumentation influence MDLs. A minimum of 7 replicate spikes at 1 to 5 times the expected MDL are analyzed. The MDL is calculated by multiplying the standard deviation of the measurements by the Student t-value for a 99 percent confidence level. Because of the wide variety of matrix types analyzed by the laboratory, MDLs are routinely determined in reagent water or standard solid matrix. These MDLs represent, therefore, the optimum values, and the MDLs for actual sample matrices are likely to be higher. MDLs can be determined for specific matrices when requested by the client.

Unless superseded by other program, project, or client requirements, IDLs and MDLs are determined annually. In addition, IDLs and MDLs are re-determined after an instrument is moved or modified, and MDLs are re-determined after a method has been significantly changed. Where more than one instrument is used in sample analyses by a given technique (e.g., gas chromatograph/mass spectrometry, gas chromatograph, graphite furnace/atomic absorption, or inductively coupled plasma), detection limit studies are performed for each instrument. A standard laboratory reporting limit is determined for each analyte based on the highest detection limit determined. Data for instruments are maintained for use in reporting data when project-specific requirements dictate lower detection limits.

A detection limit measured at a given time is an estimate of the true detection limit because the measured standard deviation used to calculate the detection limit is subject to random error and is an estimate of the population standard deviation. The confidence limits on the standard deviation and, hence the detection limit, can be determined using the chi-square (X2) distribution (40 Code of Federal Regulations 136 **Appendix B**). The 95 percent confidence limits for an MDL determined from 7 replicates are 0.64 MDL and 2.20 MDL. A re-determination of the detection limit could produce a value between the chi-square limits, even if the conditions remain the same. Day-to-day changes in instrument performance can further produce changes in the measured detection limit.

Interpreting data near detection limits can be problematic. When a measured concentration is reported as greater than the detection limit, the analyte has the specified probability of actually being present (i.e., of having a true concentration greater than zero). However, a measured concentration less than the detection limit cannot be used to draw conclusions regarding the presence or absence of an analyte in that sample. From the definition of the MDL, there is a 1 percent chance that a sample with no analyte present will be reported as a concentration greater than or equal to the MDL (false-positive). However, the probability is 50 percent that a sample with a concentration at the MDL will be measured at less than the MDL (false-negative).

3.5.2 Quantitation Levels

To ensure better precision in low-level data and to reduce the false-negative error rate, quantitation limits have been proposed as the minimum concentration at which an analyte can be quantified with an acceptable degree of confidence. The American Chemical Society Committee on Environmental Improvement has recommended that quantitation limits be calculated by multiplying 10 times the standard deviation, giving a relative standard deviation of 10 percent. The Committee further advised that quantitative interpretation, decision making, and regulatory actions should be limited to data at or above the limit of quantitation. The laboratories will use the term “Reporting Limit” for the laboratory quantitation limit.

3.5.3 Project-Specific Quality Control and Reporting Limits

The contract-required quantitation limits (CRQLs) for each Work Assignment, are the minimum levels of quantitation acceptable under the contract as listed in NYSDEC ASP 2005 Exhibit C and D, which are listed in **Appendix B**. Any project-specific revisions to these values will be addressed in the project-specific QAPP, Work Plan, and Field Activities Plan for that project.

As indicated in NYSDEC ASP (2005) Exhibit E, it is expected that the laboratories used for each Work Assignment will perform and report annual verification of MDLs by the method specified in Exhibit D (NYSDEC ASP), and that the results of the MDL study will be submitted to the NYSDEC Quality Assurance Officer. HRP will ensure that the MDLs for all samples collected each Work Assignment will meet, or be lower than, the Contract-Required Quantitation Limits (CRQLs) specified in **Appendix B** of this QAPP, unless an alternative MDL is approved by the NYSDEC Project Manager.

4.0 SAMPLE HANDLING AND CUSTODY PROCEDURES

4.1 Field Sampling Operations

The collection and subsequent laboratory analyses of environmental samples will provide the majority of the data collected during the standby contract Work Assignments. The number and types of analyses to be performed and the matrix of each of the samples are provided in each project-specific QAPP and Work Plan.

4.1.1 Sample Bottle Preparation

Chain-of-custody procedures begin with preparation of sample containers and preservatives to be used in sample collection. The standby laboratories will provide cleaned sample containers and batch-certified clean SUMMA canisters. Sample kits (coolers containing chain-of-custody forms, custody seals, sample containers, preservatives, and packing materials) will be prepared by the standby laboratories in response to receipt of the analytical task order submitted by the HRP Project Manager.

Container, preservation, and holding-time requirements for aqueous and soil samples will follow HRP's SOP for sample handling and preparation, provided in **Appendix A**. **Table 1** summarizes sampling protocols, such as container size and type, preservatives, and holding times that will generally be used during investigations conducted during Work Assignments. Project-specific sample requirements will be provided in the project-specific QAPP and Work Plan.

4.1.2 Sampling Procedures

Sampling protocols will be presented in the project-specific Work Plans and Field Activities Plans. The protocols include standard sampling procedures for sample collection, accurate sample identification, and packing of samples for shipment. Each sample container is provided with a sample label, which is filled out at the time of sample collection. During sample collection, a chain-of-custody form is initiated, which accompanies the samples during shipment to the analytical laboratory.

4.2 Laboratory Sample Receipt

Upon receipt at the laboratory, a laboratory representative inspects the samples for integrity and checks the shipment against the chain-of-custody/analytical task order form. Discrepancies are addressed at this point and documented on the chain-of-custody form and the cooler checklist. Discrepancies are reported to the Laboratory Project Manager who contacts the HRP Project Manager for resolution.

When the shipment and the chain-of-custody are in agreement, the custodian enters the samples into the Laboratory Information Management System and assigns each sample a unique laboratory number. This number is affixed to each sample bottle. The custodian then enters the sample and analysis information into the laboratory computer system.

4.2.1 Laboratory Sample Custody

The laboratory must satisfy the sample chain-of-custody requirements by implementing the following SOPs for laboratory/sample security:

- Samples are stored in a secure area
- Access to the laboratory is through a monitored area
- Visitors sign a visitor's log and are escorted while in the laboratory
- Only the designated sample custodians have keys to sample storage area(s)
- Transfers of samples in and out of storage are documented.

4.2.2 Sample Storage, Security, and Disposal

While in the laboratory, the samples and aliquots that require storage at 4°C ± 2°C are maintained in a locked refrigerator unless they are being used for analysis. The laboratory is responsible for sample storage and security to ensure that:

- Samples and extracts are stored for at least 60 days after the final analytical data report has been forwarded to the client, unless otherwise specified by DEC in coordination with the contracted laboratory. The samples, extracts, and digestates are then discarded in accordance with Occupational Safety and Health Administration guidance.

- Samples are not stored with standards or sample extracts.

5.0 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used by the laboratories are controlled by a formal calibration program, which verifies that equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. Instruments and equipment that measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration is performed using reference standards or externally by calibration agencies or equipment manufacturers. Various types of field equipment are also subject to calibration and must be calibrated in accordance with a specified program designed to ensure that each instrument is working property and the information and data obtained from the instrument will meet project-specific DQOs for the intended use of such data.

5.1 Calibration System

The following sections provide a discussion of the elements comprising the calibration system.

5.1.1 Laboratory Calibration Procedures

Written procedures are used for all instruments and equipment subject to calibration. The standby laboratories will follow NYSDEC ASP (2005) calibration procedures for laboratory equipment. Whenever possible, recognized procedures, such as those published by ASTM International or EPA, or procedures provided by manufacturers, are adopted. If established procedures are not available, a procedure is developed considering the type of equipment, stability characteristics of the equipment, required accuracy, and the effect of operational error on the quantities measured.

5.1.2 Calibration Frequency

Calibration frequency is based on the type of equipment, inherent stability, manufacturer’s recommendations, values provided in recognized standards, intended data use, specified analytical methods, effect of error upon the measurement process, and prior experience.

5.1.3 Calibration Reference Standards

Two types of reference standards will be used by the standby laboratories for calibration:

- *Physical standards*, such as weights for calibrating balances and certified thermometers for calibrating working thermometers, refrigerators and ovens, are generally used for periodic calibration.
- *Chemical standards*, such as Standard Reference Materials provided by the National Institute of Standards and Technology (NIST) or EPA. These may include vendor-certified materials traceable to NIST or EPA Standard Reference Materials. These are primarily used for operational calibration.

5.1.4 Calibration Failure

Equipment that cannot be calibrated or becomes inoperable is removed from service. Such equipment must be repaired and satisfactorily recalibrated before re-use. For laboratory equipment that fails calibration, analysis cannot proceed until appropriate corrective action is taken and the analyst achieves an acceptable calibration. This is documented in a Non-Conformance Record, which is discussed in Section 11.

Laboratory managers are responsible for development and implementation of a contingency plan for major equipment failure. The plan includes guidelines on waiting for repairs, use of other instrumentation, subcontracting analyses, and evaluating scheduled priorities.

5.2 Operational Calibration

Operational calibration is generally performed as part of the analytical procedure and refers to those operations in which instrument response (in its broadest interpretation) is related to analyte concentration. Included is the preparation of a standard response (calibration) curve and often the analysis of blanks.

5.2.1 Preparation of Calibration Curve

Preparation of a standard calibration curve is accomplished by the analysis of calibration standards, which are prepared by adding the analyte(s) of interest to the solvent that is introduced into the instrument. The concentrations of the calibration standards are chosen to cover the working range of the instrument or method. Sample measurements are made within this working range. The calibration curve is prepared by plotting or regressing the instrument responses versus the analyte concentrations. Concentrations of the analyzed samples are back-calculated from the calibration curve.

5.2.2 Blanks

Reagent and/or solvent blanks are analyzed to assess if the materials used to prepare the standards are free from interfering substances that could affect the analysis. A method blank is prepared whenever samples are processed through steps that are not applied to the calibration standards.

5.3 Periodic Calibration

Periodic calibrations are performed for equipment (e.g., balances, thermometers) that is required in the analytical method, but that is not routinely calibrated as part of the analytical procedure. The periodic calibration requirements used by the standby laboratories will be provided in **Table 2**. It should be noted that each standby laboratory may calibrate more equipment than what is presented in the table; in this instance the requirements will be included in the project-specific QAPP. Each laboratory will maintain on-site copies of all calibrations completed.

5.4 Field Equipment Calibration

The frequencies and standards used for the calibration of field equipment are provided in **Table 3**.

5.5 Calibration Records

Records are prepared and maintained for each piece of equipment (laboratory and field equipment) subject to calibration. Records demonstrating accuracy of preparation, stability, and proof of continuity of reference standards are also maintained. The standby laboratory maintains these documents on-site. Copies of the raw calibration data are kept with the analytical sample data. HRP maintains such records for field equipment used during Work Assignments in the project-specific file. A copy of the calibration records are also maintained by the HRP Field Services Department for all equipment owned by HRP.

6.0 ANALYTICAL PROCEDURES

6.1 Field Analytical Procedures

Field analytical procedures include the measurement of temperature, conductivity, dissolved oxygen, pH, turbidity, organic vapors, and groundwater levels. Site personnel will follow HRP's SOPs for field screening and sample handling and preparation. Project-specific field-measurement protocols are presented in each project-specific Work Plan and Field Activities Plan. Typical field measurement QC limits in terms of precision and accuracy are presented in **Table 4**. Changes to these typical values would be included in the project-specific QAPP, Work Plan, and Field Activities Plan.

6.2 Laboratory Analytical Procedures

Laboratory analytical requirements presented in the subsections below include a general summary of project-specific requirements related to each sample matrix to be analyzed. In accordance with NYS Public Health Law Section 502, environmental samples must be analyzed by laboratories accredited by the NYS Department of Health Environmental Laboratory Approval Program. Each analytical laboratory is responsible for maintaining internal quality controls as part of their quality assurance plan.

Concentrations of target compounds and analytes will be analyzed according to the laboratory-specific method SOPs developed for the NYSDEC ASP (2005) and EPA SW-846 Methods listed in the table below. Methods not listed in the table below are listed in the NYSDEC ASP (2005). Additional information regarding the number and types of samples to be collected at each area of concern will be presented in each project-specific Work Plan and Field Activities Plan.

Analyte List	Matrices	Method No.
EPA CLP Target Compound Lists for volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs)	Groundwater, surface water, surface and subsurface soil, sediment, and debris	EPA SW-846 Method 8260C for VOCs EPA SW-846 Method 8270D for SVOCs
EPA CLP Target Analyte List for metals	Groundwater, surface water, surface and subsurface soil, sediment, and debris	EPA Method 6010C Mercury by Cold Vapor AAS (SW-846 Method 7471A/B)
Polychlorinated biphenyls	Groundwater, surface water, surface and subsurface soil, sediment, and debris	EPA SW-846 Method 8082/A
VOCs	Air and Soil Vapor	EPA TO-15, EPA TO-14A
NOTE: Specific methods or target analyte lists that might be used for a specific project will be identified in the project-specific QAPP and project-specific Work Plan. AAS = Atomic Adsorption Spectrophotometer		

Samples will be analyzed by the laboratory within the holding times presented in each project-specific Work Plan and Field Activities Plan on a standard turnaround schedule, unless a shorter turn-around time is requested by HRP or NYSDEC.

6.3 Sample Matrices

6.3.1 Water

No laboratory filtering of groundwater samples will be performed. Analytical results for laboratory analyses will be reported in units identified in **Appendix B**.

6.3.2 Soil, Sediment and Debris

Analytical results of soil, sediment, and debris samples will be reported in terms of dry weight in the units identified in **Appendix B**.

6.3.3 Soil Vapor and Indoor/Outdoor Air

Analytical results for soil vapor and indoor/outdoor air samples will be reported in terms of volume in the units identified in **Appendix B**.

6.4 Standard Operating Procedures

The standby laboratories will maintain a manual of procedures other than laboratory-specific analytical methods in a document-controlled SOP Manual. Laboratory Method SOPs will be maintained as controlled documents in the laboratory's Methods Manuals.

6.5 Recordkeeping

The requirements for laboratory recordkeeping are provided in the laboratory's SOP Manual. Data entries are made in indelible, water-resistant ink. The date of the entry and the observer are clear on each entry. The observer uses his/her full name or initials. An initial and signature log is maintained so that the recorder of every entry can be identified. Information is recorded in a notebook or on other records at the time the observations are made. Recording information on loose pieces of paper is not allowed.

When a mistake is made, the wrong entry is crossed out with a single line initialed and dated by the person making the entry, and the correct information recorded. Obliteration of an incorrect entry or writing over it is not allowed; neither is the use of correction tape or fluid on any laboratory records.

7.0 LABORATORY AND FIELD QUALITY CONTROL CHECKS AND FREQUENCY

QC measurements for analytical protocols are designed to evaluate laboratory performance and measurement bias resulting from the sample matrix and field performance.

- *Laboratory Method Performance* - QC criteria for method performance must be met for all target analytes for data to be reported. These criteria generally apply to instrument tune, calibration, method blanks, laboratory control samples, and Standard Reference Materials.

- *Sample Performance* - The accuracy and precision of sample analyses are influenced by both internal and external factors. Internal factors are those associated with sample preparation and analysis. Internal factors are monitored by the use of laboratory QC samples. Field QC samples are analyzed to determine any measurement bias due to the sample matrix based on evaluation of matrix spikes, matrix spike duplicates, and laboratory duplicates.

- *Field Performance* - QC samples are collected to evaluate the effectiveness of the sampling program in obtaining representative samples and identifying whether cross-contamination has occurred.

7.1 Laboratory Quality Control Samples

Laboratory QC samples are included in each analysis to provide information on both method performance and sample measurement bias and are included with each analytical batch. A batch is defined as a group of field samples of similar matrix, not to exceed 20, which are processed as a unit using the same method and the same lots of standards and reagents. The laboratory QC samples discussed in the following sections are not counted in the maximum batch size of 20.

7.1.1 Method Blank

The method blank is used to monitor laboratory contamination. This is usually a sample of laboratory reagent water, or a standard solid matrix, processed through the same analytical procedure as the sample (i.e., digested, extracted, distiilled). One method blank is prepared and analyzed with each analytical batch.

7.1.2 Laboratory Control Sample

A fortified method blank is analyzed with each analysis. These samples generally consist of a standard matrix fortified with the analytes of interest for single-analyte methods and selected analytes for multi-analyte methods according to the appropriate analytical method. The analyte recovery from each is used to monitor analytical accuracy and precision.

7.1.3 Matrix Spike

A matrix spike is an aliquot of a field sample, which is fortified with the analyte(s) of interest and analyzed to monitor measurement bias associated with the sample matrix. A matrix spike and matrix spike duplicate will be performed for every laboratory analytical batch. Only matrix spikes performed on samples collected from the specific site associated with the Work Assignment can be used to evaluate matrix interference for the specific media. Use of site-specific matrix spikes and matrix spike duplicates will be identified in the project-specific QAPP, Work Plan, and Field Activities Plan.

7.1.4 Surrogates

Surrogates are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but are not normally found in environmental samples. Surrogates are added to field and QC samples in every batch. These compounds are used to monitor system performance as well as sample measurement bias. Percent recoveries are calculated for each surrogate, and evaluated against acceptance criteria.

7.2 Field Quality Control Samples

Field quality control samples are not included specifically as laboratory QC samples but are analyzed when submitted. Data for these QC samples are reported with associated samples. Often, and in accordance with project-specific DQOs, field QA/QC samples will be submitted to the laboratory with no identification that the samples submitted are QA/QC samples (i.e., submitted “blind”). In such cases, the laboratory will not be able to associate the QC samples with any specific sample location, which helps ensure that such samples are analyzed and managed in the same way as any other field sample. Such an approach provides an added level of confidence in the evaluation of results for such samples relative to the actual field samples.

7.2.1 Field Blanks

Field blanks will be collected to determine if there is cross-contamination of samples from dust, off-gassing, and/or contaminants in the air during the time when samples are being collected in the field. Field blanks will be collected at a frequency requested in the Work Assignment, and site-specific information related to the collection of field blanks will be provided in the project-specific QAPP, Work Plan, and Field Activities Plan.

The analytical laboratory will provide field blank DI water and sample jars for the collection of all field blanks. Glass jars will be used for organic blanks. The field blanks as well as the trip blanks will accompany field personnel to the sampling location.

Field blank sample bottles provided by the laboratory will be opened on-site and then resealed and place sample in a cooler and maintain a temperature of 4ºC until receipt by the laboratory.

All sample logs, labels, and chain-of-custody forms for field blank samples will be filled out and recorded in field logbook as for any other sample collected.

7.2.2 Equipment Blanks

Equipment blanks will be collected to evaluate the cleanliness of sampling equipment for soil and aqueous samples, and the potential for cross-contamination of samples due to equipment handling, decontamination and/or contaminants in the ambient air during sample collection. Equipment blanks will be collected at a minimum frequency of one per equipment type and/or media per day. Equipment blanks will not be collected in conjunction with the collection of air or vapor samples.

Equipment blanks will be collected during the course of an analytical field sampling event by pouring deionized or potable water over a particular piece of sampling equipment and into a sample container. The analytical laboratory will provide equipment blank water and sample jars with preservatives for the collection of all equipment blanks. Glass jars will be used for organic blanks. The equipment blanks, as well as the trip blanks, will accompany field personnel to the sampling location. The equipment blanks will be analyzed for the same analytes as the environmental samples being collected that day and shipped with the samples taken. In some cases, it may be acceptable to collect an equipment blank that will also serve as a field blank. Should this be determined to be appropriate for a specific project, such information will be conveyed in the project-specific QAPP, Work Plan, and Field Activity Plan.

Equipment blanks will be collected in accordance with the procedures described below:

- Decontaminate sampling device in accordance with procedures described in the applicable SOP or the project-specific Field Activity Plan.
- Pour distilled/deionized water over the sampling equipment, and collect the rinsate water in the appropriate bottles.
- Immediately place sample in a cooler and maintain a temperature of 4ºC until receipt by the laboratory.

Fill out sample log, labels, and constituents of concern forms, and record in field logbook.

7.2.3 Trip Blanks

The trip blank will be used to determine if any volatile organic cross-contamination occurs between aqueous samples during shipment. Trip blanks are only used for samples to be analyzed for volatile organic compounds (VOCs). Trip blanks will be supplied by the analytical laboratory as aliquots of distilled, deionized water that will be sealed in a sample bottle prior to initiation of each day of field work. Glass vials (40 ml) with Teflon®-lined lids will be used for trip blanks. The sealed trip blank bottles will be placed in a cooler with the empty sample bottles and shipped to the site by laboratory personnel. If multiple coolers are necessary to store and transport samples to be analyzed for VOCs, each cooler must contain an individual trip blank. Therefore, efforts will be made to include all samples to be analyzed for VOCs in a smallest number of coolers. However, if particularly contaminated samples have been collected during the same sampling event as samples expected to contain low levels of VOCs, it would be more appropriate to separate the more contaminated samples from those with lower anticipated levels of contamination. If such a situation is anticipated, the approach and applicable procedures should be described in the project-specific QAPP, Work Plan, and Field Activities Plan. Trip blanks will not be collected in conjunction with the air or soil vapor samples.

7.2.4 Field Duplicates

Field duplicates are two samples of the same matrix, often referred to as “replicate samples,” that are collected, to the extent possible, from the same location at the same time using the same techniques. Field duplicates provide information on the precision of the sampling and analysis process. Field duplicates will be collected at a minimum frequency of 1 duplicate per 20 samples from each environmental media. Separate duplicate samples will be collected for the following media: surface and subsurface soil, sediment, surface water, groundwater, air, and soil vapor samples. Project-specific information on duplicate sampling will be provided in the project-specific QAPP, Work Plan, and Field Activities Plan.

7.2.5 Matrix Spike / Matrix Spike Duplicates

If determined to be necessary by the HRP’s QA Officer and/or NYSDEC Project Manager, specific sampling locations/sampling intervals will be selected for collection of additional replicate samples of the environmental media that will be analyzed as matrix spike/matrix spike duplicate (MS/MSD) samples. The need for collection of MS/MSD samples and specific details regarding the collection of such samples will be identified in the project-specific QAPP and Work Plan.

7.2.6 Temperature Blanks

Laboratory will use either 1) an infrared instrument to measure the temperature of liquid samples or 2) a temperature blank will be used to measure the temperature of liquid samples. If used, temperature blanks will be supplied by the analytical laboratory. If multiple coolers are necessary to store and transport aqueous samples, then each cooler must contain an individual temperature blank (if used).

8.0 PREVENTIVE MAINTENANCE

Periodic preventive maintenance is required for all sensitive equipment. Instrument manuals will be kept on file for reference if equipment needs repair. The troubleshooting chapter of factory manuals may be used in assisting personnel in performing maintenance tasks. The frequency of preventive maintenance for field equipment is indicated in each operating instruction manual.

Field equipment is checked by field personnel under the supervision of HRP’s Technical Services Group’s Field Manager and/or Project Manager based on the individual’s experience with the specific instrument. It is the responsibility of HRP’s Technical Services Group’s Field Manager or his/her qualified designee to conduct preventive maintenance. A summary of general preventative maintenance schedule is provided in **Table 5**.

Major instruments in the laboratory are covered by annual service contracts with manufacturers. Under these agreements, regular preventive maintenance visits will be made by trained service personnel. Maintenance is documented and maintained in permanent records by the individual responsible for each instrument.

Laboratory management is responsible for preparation and documentation of the laboratory’s preventative maintenance program. Section Chiefs and QC Chemists implement the program, and the Quality Services Manager reviews implementation to verify compliance. For each operational group, the preventive maintenance program includes the following:

- Listing of the instruments and equipment that are included in the program
- Frequency of maintenance considering manufacturer’s recommendations and/or previous experience with equipment
- For each instrument in the program, a file is maintained for the following information:
    - List of spare parts maintained by the laboratory
    - External service contracts
    - Items to be checked and/or serviced during maintenance and directions for performing maintenance (if external service is not provided of if not stated in manufacturer’s instrument manuals).

9.0 QUALITY ASSURANCE PERFORMANCE AND SYSTEM AUDITS

Audits are systematic checks to determine the quality of operation of some activity or function in the field or laboratory. Field audits will be conducted to assure adherence to proper field and sampling procedures. The number of audits performed during a project will depend on the length of time over which auditable activities occur, but at least one audit will be performed during the course of a project.

Several factors will influence the number of audits that might be appropriate for a given Work Assignment. For example, for field audits, such factors would include the number of different types of field activities that are performed, the number of different field personnel conducting a specific field activity, and whether any non-conformances (and the nature of such non-conformances) have been identified during a prior audit for that project. Specific auditing of field activities that is planned for any Work Assignment will be identified in the project-specific QAPP and Work Plan. Auditing for laboratory activities will be in accordance with laboratory QA/QC and New York State Department of Health ELAP procedures.

Audits are of two types:

- *Performance audits* are independent safety and health, procedure, and/or sample checks made by a supervisor or auditor to arrive at a **quantitative** measure of the quality of the data produced by one section or the entire measurement process.

- *System audits* are on-site **qualitative** inspections and reviews of the QA system used by some part of or the entire measurement system. The audits are performed with respect to whether elements identified in the QAPP and/or Work Plan are performed properly. A checklist is typically generated from the requirements and becomes the basis for the audit. The results of any deficiencies noted during the audit are summarized in an audit report.

Laboratory performance and system audits are performed by the QA staff to assess the effectiveness of the quality system. These internal audits are performed on a routine basis. Audits are also performed by certifying agencies. Audit reports and corrective actions are available to NYSDEC for review.

9.1 Responsibility, Authority, and Timing

QA audits to be conducted for the project may include system, performance, and data audits. The Contract QA Officer will keep a tentative schedule on record that details the number and types of audits.

9.2 Field Audits

Field performance audits will be conducted on an ongoing basis during the project as field data are generated, reduced, and analyzed. All numerical manipulations, including manual calculations, will be documented. All records of numerical analyses will be legible, of reproduction quality, and sufficiently complete to permit logical reconstruction by a qualified individual other than the originator.

Indicators of the level of field performance include the analytical results of the blank and replicate samples. Each blank analysis will be considered an indirect audit of the effectiveness of measures taken in the field to ensure sample integrity (e.g., field decontamination procedures). The results of the field replicate analyses are an indirect audit of the ability of each field team to collect representative sample portions of each matrix type.

System audits of site activities will be accomplished by an assessment of all field site activities. During this audit, the auditor(s) will compare existing field practices with standard procedures, as described in the project-specific QAPP, Field Activities Plan, and Work Plan. The audit will particularly focus on whether all procedures and analyses are being conducted in accordance with procedures outlined in those documents.

Specific elements to be evaluated during the field system audit include:

- Sample documentation
- Working order of instruments and equipment
- Level of QA conducted per each field team
- Contingency plans in case of equipment failure or other event preventing the planned activity from proceeding
- Decontamination procedures
- Level of efficiency with which each team conducts planned activities at one site and proceeds to the next
- Sample packaging and shipment.

After completion of the audit, any deficiencies will be discussed with the field staff and corrections identified. If any of these deficiencies could affect the integrity of the samples being collected, the auditor(s) will inform the field staff and corrections will be implemented immediately. Field audits will be performed by the Contract QA Officer, project-specific QA Officer (if not the Contract QA Officer) and/or the Project Manager or their properly qualified designee.

9.3 Laboratory Performance and System Audits

A certified laboratory that has satisfactorily completed performance audits and performance evaluation samples in accordance with The New York State Department of Health ELAP Contract Laboratory Program will be used for all sample analysis. The results of the most recent performance audits and performance evaluations will be made available upon request.

9.4 Audit Procedures

The Contract QA Officer will ensure that a standard audit form is used for all field audits. During an audit and upon its completion, the auditor(s) will discuss the findings with the individuals audited and discuss and agree on corrective actions to be initiated. The auditor will then prepare and submit an audit report to the manager of the audited group, the Project Manager, the Project QA Officer(if applicable), and the Contract QA Officer.

The manager of the audited group will then prepare and submit, to the Contract QA Officer and the Project Manager (and project QA Officer, if applicable), a plan for implementing the corrective action to be taken on non-conformances indicated in the audit report, the date by which such corrective action will be completed, and actions taken to prevent reoccurrence. If the corrective action has been completed, supporting documentation should be attached to the reply. The auditor will ascertain (by re-audit or other means) if appropriate and timely corrective action has been implemented.

Records of audits will be maintained in the project files.

9.5 Documentation

To ensure that the previously defined scope of the individual audits is accomplished and that the audits follow established procedures, a checklist will be completed during each audit. The checklist will detail the activities to be executed and ensure that the auditing plan is accurate. Audit checklists will be prepared in advance and will be available for review. Following each system, performance, and data audit, the Quality Services Manager (for laboratories) or the Project QA Officer (for field audits) will prepare a report to document the findings of the specific audit.

10.0 DATA REDUCTION, VERIFICATION, VALIDATION, AND REPORTING

10.1 Data Reduction

10.1.1 Field and Technical Data Reduction

Field personnel will record all field data in bound field logbooks and on standard forms. After checking the validity of the data in the field notes, the Project Manager and/or General Supervisor or his/her designee will reduce the data to tabular form, when possible, by entering the data into an electronic database. Where appropriate, the data files will be set up for direct input into the electronic project database. Subjective data will be filed as hard copies for later review by the Project Manager and appropriate members of the project team and incorporation into technical reports, as appropriate.

10.1.2 Laboratory Data Reduction

Data reduction is the process by which raw analytical data generated from laboratory instrument systems is converted into usable concentrations. The raw data, which may take the form of area counts, instrument responses, or observations, are processed by the laboratory and converted into concentrations expressed in appropriate units for the specific analyte or analytical group. Raw data from these systems include compound identifications, concentrations, retention times, and data system print-outs. Raw data are usually reported in graphic form, bar graph form, or tabular form. The laboratory will follow standard operating procedures consistent with the data handling requirements of the applicable methods.

The laboratory reporting limits for each project must be less than or equal to those stipulated for each Work Assignment. Contract-required quantitation limits are presented in **Appendix B** of this QAPP.

10.2 Data Verification

10.2.1 Field and Technical Data Verification

Verification of objective field and technical data will be performed at different levels and at different stages of the project. The first level of data verification will be performed at the time of collection by following standard procedures and QC checks. Field work sheets will be reviewed by the Project Manager or his/her designee for completeness and accuracy for each project within one to days of each day of field work. The Project Manager or designee will make any necessary inquiries with field personnel regarding missing information or data or suspected inconsistencies or errors in the field reports within one to two days of identifying such issues and will follow up to ensure that any necessary corrections or changes have been made, not just to the field reports themselves, but also with respect to any necessary changes that might be necessary to the field program based on identified issues.

Final review of field work sheets will be conducted following completion of the field sampling activities and prior to placement of the work sheets into the project file. The work sheets, including any necessary corrections, will be included in the final project report.

Auditing of field activities by the Project Manager, Project QA Officer, or a qualified designee will provide random checks of sampling and field conditions as the field activities are occurring. Once field data has been organized and, as appropriate, entered into an electronic database, the Project Manager or designee will then review the data to ensure that the correct codes and units have been included and will review data sets for anomalous values and other issues that might affect the quality of the field data generated for the project. This task will generally be conducted as soon as possible after data has been organized into tables, graphs, and/or figures, with the objective of reviewing the data within a time-frame that will permit additional data collection, if necessary, to obtain a dataset that will meet the project-specific DQOs.

10.2.2 Analytical Data Validation

If a Work Assignment requires the validation of data, formal data validation will be performed to establish the quality for all analytical data that will be used when making project decisions. Laboratories will submit results that are supported by sufficient back-up data and QA/QC results to enable the reviewer to conclusively determine the quality of the data. The laboratory will review data prior to its release from the custody of the laboratory. The laboratory is required to evaluate and confirm their ability to meet the objectives for data quality (data quality objectives) established for each project and identified in each project-specific QAPP, Work Plan, and/or FAP. Outlying data will be flagged in accordance with laboratory standard operating procedures, and corrective action will be taken to rectify the problem.

The purpose of data validation is to identify and document the quality of the analytical data generated by the laboratory, as all data used for decision-making purposes must be of known and acceptable quality for the intended use of the data. The person performing the data validation effort must be independent of the laboratory that generated the data. When full data validation is deemed necessary by the NYSDEC project manager, a NYSDEC-approved, qualified, independent third-party data validator, as described in the Schedule 1 of the Standby Contract D009808 (Attachment 1) will review the data package to determine completeness and compliance in accordance with that document.

A narrative describing how the data did or did not meet the validation criteria is part of the data validation procedure. The validation assessment will describe the overall quality of the data and the data validation report will provide a written statement upon completion of the validation indicating whether or not the data are valid and usable and will include a percent completeness value of usable data, and a spreadsheet that summarizes the results of the data validation effort. The data validation report will be reviewed by the QA Officer.

10.2.3 Data Usability Summary Report

For all data generated during Work Assignments, a Data Usability Summary Report (DUSR) will be prepared to provide a thorough evaluation of analytical data without third-party data validation. The primary objective of a DUSR is to determine whether the data, as presented, meet the project-specific criteria for data quality and usability, as indicated in the project-specific data quality objectives established in the project-specific QAPP, Work, and FAP. The DUSR will be prepared by a NYSDEC-approved qualified environmental scientist in accordance with Schedule 1 of the Standby Contract D009808 and will be reviewed by the QA Officer.

10.3 Reporting

10.3.1 Field Measurements

Any field analysis results will be recorded in a dedicated field logbook at the time the results are available. The field logbook will be reviewed by the General Supervisor and/or the Project Manager for completeness and accuracy within one to two days. The General Supervisor and/or the Project Manager will make any necessary inquiries with Field Personnel regarding missing information or data or suspected inconsistencies or errors in the field reports within one to two days of identifying such issues and will follow up to ensure that any necessary corrections or changes have been made, not just to the field reports themselves, but also with respect to any necessary changes that might be necessary to the field program based on identified issues. Final review of field work sheets will be conducted following completion of the field sampling activities and prior to placement of the work sheets into the project file.

The results will be tabulated and plotted in the office as part of the reporting tasks. Reports also will consist of the field logbook, required field data forms and work sheets, photographic documentation, and daily QC reports, as applicable. The work sheets, including any necessary corrections, will be included in the final project report.

10.3.2 Analytical Data

The content of analytical laboratory data packages designed for work conducted in association with each Work Assignment are site-specific and will include the following information:

- Pertinent physical data presented in concise, easy to follow formats (i.e., sample number, client, date of sample preparation, date analyzed, percent moisture, etc.)
- Reference for the analytical methodology used
- General discussion including a description of sample types, tests performed, any problems encountered, and general comments
- Data from each discrete sample, including all pertinent dates, information, and reporting limits
- Data for associated QC samples such as blanks, spikes and spike duplicates, laboratory duplicates, field duplicates, and appropriate check standards. (In some cases, field QC samples will not be provided as such to the laboratory, instead being submitted to the laboratory in a “blind” manner so the laboratory is not alerted to the fact that specific samples are actually QC samples.)
- Copies of chain-of-custody sheets
- Raw data.

11.0 CORRECTIVE ACTION PROCEDURES

11.1 Objectives

The objectives of the corrective action procedures presented below are to ensure that recognized errors in performance of sample and data acquisition lead to effective remedial measures and that those steps are documented to provide assurance that any data quality deficiencies are recognized in later interpretation and taken into account during the evaluation of data usability. The overall objective of corrective action procedures is to ensure that the activity that required corrective action does not recur.

11.2 Rationale

Many times corrective measures are undertaken in a timely and effective fashion but go undocumented. In other cases, corrective actions are of a complex nature and may require scheduled interactions between departmental groups. In either case, documentation in a formal or informal sense can reinforce the effectiveness and duration of the corrective measures taken.

11.3 Corrective Action Methods

11.3.1 Corrective Action Steps

Immediate corrective actions are of a minor or routine nature such as correcting malfunctioning equipment, correction of data transcription errors, and other such activities routinely made in the field, laboratory, or office by technicians, analysts, and other project staff.

11.3.2 Long-Term Corrective Actions

Long-term corrective action will be used to identify and eliminate causes of non-conformances which are of a complex nature and that are formally reported between management groups.

11.3.3 Corrective Action Steps

For long-term corrective actions, steps comprising closed-loop corrective action system are as follows:

- Define the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Determine a corrective action to eliminate the problem
- Assign and accept responsibility for implementing the corrective action
- Verify that the corrective action has eliminated the problem.

11.3.4 Audit-Based Non-Conformances

Following audits, corrective action is initiated by documenting the audit finding and recommended corrective action on an Audit Finding Report.

11.4 Corrective Action Report Review and Filing

Immediate and long-term corrective actions require review to assure that, during the time of non-conformance, erroneous data were not generated or that, if possible, correct data were acquired instead. Such initial confirmation and review is the responsibility of the supervisor of the staff implementing the corrective action. Confirmation will be acknowledged by notation and dated signature on the affected data record or appropriate form or by memorandum to the Project Manager, Project QA Officer (if applicable), and Contract QA Officer. Such notification of the initial issue and corrective action must be made in a sufficient time-frame that any necessary additional actions can be taken to ensure the collection of data that meets the project-specific DQOs.

11.5 Corrective Action Reports to Management

The Contract Manager will be informed verbally of non-conformance events as soon as possible, and decisions made after evaluation is documented in the Non-Conformance Records. The Contract QA Officer will provide the Contract Manager with corrective action reports in a timely manner. A copy of each Non-Conformance Record is maintained in the report.

12.0 QUALITY ASSURANCE REPORTS

Fundamental to the success of the QA/QC effort is the active participation of the Project Manager, General Supervisor, Project QA Officer (when that role is fulfilled by someone other than the Contract QA Officer), and the Contract QA Officer. The Contract QA Officer will be advised of project activities and will participate in development, review, and operation of the project. Project management will be informed of QA activities through the receipt, review, and/or approval of:

- Project- or task-specific work plans and QAPPs
- Corporate and project-/task-specific QA/QC plans and procedures
- Corrective action notices
- Non-conformance records.

Periodic assessment of field and laboratory QA/QC activities and data accuracy, precision, and completeness will be conducted and reported by the Contract QA Officer and the laboratory Quality Services Manager, as appropriate relative to the specific activity. Items to be included in the QA reports are the summary of results for the performance or the system audit and, where applicable:

- Assessment of adherence to work scope and schedule for the audited task
- Assessment of the precision, accuracy, and completeness of sample batches and subsequent status of data processing and analyses
- Significant QC problems and the status of any ongoing corrective actions
- Changes to the project-specific Work Plan, Field Activities Plan, and or QAPP
- Status of implementation of the project-specific Work Plan, Field Activities Plan, and or QAPP.

13.0 REFERENCES

New York State Department of Environmental Conservation (NYSDEC). 2010. *DER-10, Technical Guidance for Site Investigation and Remediation*, Division of Environmental Remediation. May 2010.

NYSDEC. 2005. Analytical Service Protocol, July 2005.

NYSDEC, Technical Procedure Guidance, Quality Assurance/Quality Control Procedures, *Spill Guidance Manual*, Section 2.4.

NYSDEC, Technical Procedural Guidance, Equipment Training, Calibration, and Maintenance, *Spill Guidance Manual*, Section 2.2.

U.S. Environmental Protection Agency (USEPA). 2019. *Test Methods for Evaluating Solid Waste, Laboratory Manual Physical/Chemical Methods*, Office of Solid Waste and Emergency Response, SW-846, through Update VI, Phase III.

USEPA. 2017. *Standard Operating Procedure Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity)*, USEPA, Region 1, Quality Assurance Unit, Revision Number 3, Revised March 23, 2017.

USEPA. 2004. *Guidance for Development of Quality Assurance Project Plans for Environmental Monitoring Projects*, USEPA Region 2, Division of Environmental Science and Assessment, April 12, 2004.

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TABLE 1

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING-TIME REQUIREMENTS

Soil

					Containers per Sample			Preservation Requirements			
Parameter	**Matrix**	**Number of Samples (including Field QC)**	**Preparation Method**	**Analytical Method***	**No.**	**Size**	**Type**	**Temp.**	**Light Sensitive**	**Chemical**	**Maximum Holding Time**
VOCs by GC/MS	Soil/Sediment	Provided in project-specific QAPP	5035A	SW-846 Method 8260B	3 vials 1 jar	40 ml vials, any size jar	glass vials clear glass jar	2-6º C	No	MeOH/ Sodium bisulfate/deionized water/freezing	14 days * *
SVOCs by GC/MS	Soil/Sediment	Provided in project-specific QAPP	3546	SW-846 Method 8270C	1	8 oz	amber glass jar	2-6º C	Yes	NA	14 days
Trace metals by ICP-AES	Soil/Sediment	Provided in project-specific QAPP	3050B	SW-846 Method 6010B	1	8 oz	clear glass jar	NA	No	NA	6 months
Mercury by Cold Vapor AAS	Soil/Sediment	Provided in project-specific QAPP Addendum	Inc. in 7471A method	SW-846 Method 7471A	1	8 oz	clear glass jar	NA	No	NA	28 days
Trace Metals by AAS and Direct Aspiration	Soil/Sediment	Provided in project-specific QAPP	3050B	SW-846 Method 7000 series	1	8 oz	clear glass jar	NA	No	NA	6 months
PCBs by GC	Soil/Sediment	Provided in project-specific QAPP	3546	SW-846 Method 8082	1	8 oz	clear glass jar	2-6º C	No	NA	14 days
Chlorinated Pesticides by GC	Soil/Sediment	Provided in project-specific QAPP	3546	SW-846 Method 8081A	1	8 oz	clear glass jar	2-6º C	No	NA	14 days
Total and Physiologically Available Cyanide	Soil/Sediment	Provided in project-specific QAPP	Inc. in 9014 method	Modified SW-846 Method 9014	1	8 oz	plastic jar	2-6º C	No	NA	14 days
Colorimetric Hexavalent Chromium	Soil/Sediment	Provided in project-specific QAPP	3060A	SW-846 Method 7196A	1	8 oz	clear glass jar	2-6º C	No	NA	30 days
Total Petroleum Hydrocarbons	Soil/Sediment	Provided in project-specific QAPP	3646	SW-846 Method 8100	1	8 oz	clear glass jar	2-6º C	No	NA	14 days
TPH	Soil/Sediment	Provided in project-specific QAPP	3546	SW-846 Methods 8015M/8015B/8100	1	8 oz	clear glass jar	2-6º C	No	NA	14 days
TCLP 1311	Soil/Sediment	Provided in project-specific QAPP	NA	SW-846 Method 1311	1	8 oz	analysis specific see method	NA	NA	NA	NA
SPLP 1312	Soil/Sediment	Provided in project-specific QAPP	NA	SW-846 Method 1312	1	8 oz	analysis specific see method	NA	NA	NA	NA

TABLE 1

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIME REQUIREMENTS (Continued)

Groundwater

					Containers per Sample			Preservation Requirements			
Parameter	Matrix	Number of Samples (including Field QC)	Preparation Method	Analytical Method*	No.	Size	Type	Temp.	Light Sensitive	Chemical	Maximum Holding Time
VOCs by GC/MS	Aqueous	Provided in project-specific QAPP	5035	SW-846 Method 8260B	2	40 ml	glass vial	2-6º C	No	HCL	14 days
SVOCs by GC/MS	Aqueous	Provided in project-specific QAPP	3510C	SW-846 Method 8270C	2	1 liter	amber bottle	2-6º C	Yes	NA	7 days
Trace metals by ICP-AES	Aqueous	Provided in project-specific QAPP	3005A	SW-846 Method 6010B	1	250 ml	plastic bottle	NA	No	Nitric Acid	6 months
Mercury by Cold Vapor AAS	Aqueous	Provided in project-specific QAPP	Inc. in 7470 method	SW-846 Method 7470A	1	250 ml	plastic bottle	NA	No	Nitric Acid	28 days
Trace Metals by AAS and GF	Aqueous	Provided in project-specific QAPP	3050B	SW-846 Method 7000 series	1	250 ml	plastic	NA	No	Nitric Acid	6 months
Trace Metals by AAS and Direct Aspiration	Aqueous	Provided in project-specific QAPP	3005A	SW-846 Method 7000 series	1	250 ml	plastic	NA	No	Nitric Acid	6 months
ETPH	Aqueous	Provided in project-specific QAPP	3510C	CT ETPH	1	1 liter	amber bottle	2-6º C	Yes	NA	7 days
PCBs by GC	Aqueous	Provided in project-specific QAPP	3510C	SW-846 Method 8082	2	liter	clear glass bottle	2-6º C	No	NA	7 days
Chlorinated Pesticides by GC	Aqueous	Provided in project-specific QAPP	3510C	SW-846 Method 8081	2	liters	clear glass bottle	2-6º C	No	NA	7 days
Total and Physiologically Available Cyanide	Aqueous	Provided in project-specific QAPP	Inc. in 9014 method	Modified SW-846 Method 9014	1	250 ml	plastic bottle	2-6º C	No	NaOH	14 days
Colorimetric Hexavalent Chromium	Aqueous	Provided in project-specific QAPP	Inc. in 7196 method	SW-846 Method 7196A	1	250 ml	plastic bottle	2-6º C	No	NA	24 hours
EDB and DBCP	Aqueous	Provided in project-specific QAPP	Inc. in 504.1 method	EPA Method 504.1	2	40 ml	vials	2-6º C	No	Sodium Thiosulfate	14 days
VOCs by GC/MS	Aqueous	Provided in project-specific QAPP	Inc. in 624 method	EPA Method 624	2	40 ml	vials	2-6º C	No	HCL * * *	14 days
ICP-MS	Aqueous	Provided in project-specific QAPP	3005A	EPA Method 6020A	1	250 ml	plastic bottle	NA	No	Nitric Acid	6 months
200.7	Aqueous	Provided in project-specific QAPP	3005A	EPA Method 200.7	1	250 ml	plastic bottle	NA	No	Nitric Acid	6 months
TPH	Aqueous	Provided in project-specific QAPP	3510C	SW-846 Method 8015M/8015B/8100	1	1 liter	amber bottle	2-6º C	No	NA	7 days
Total Hardness	Aqueous	Provided in project-specific QAPP	NA	EPA 130.2	1	250 ml	plastic bottle	2-6º C	No	NA	6 months
Reactivity	Aqueous	Provided in project-specific QAPP	NA	Sulfide=7332930A, Cyanide=SW9014	1	500 ml	plastic bottle	2-6º C	No	NA	14 days
Conductivity	Aqueous	Provided in project-specific QAPP	NA	EPA Method 2510B	1	250 ml	plastic bottle	2-6º C	No	NA	28 days
Flashpoint	Aqueous	Provided in project-specific QAPP	NA	SW-846 Method 1010	1	flashpoint bottle	amber, small neck	2-6º C	Yes	NA	asap
Sulfide	Aqueous	Provided in project-specific QAPP	NA	SN4500S2E	1	250 ml	plastic bottle	2-6º C	no	0.43 ml Zn acetate & 0.50 ml NaOH	7 days
Chloride	Aqueous	Provided in project-specific QAPP	NA	SM4500CLB	1	250 ml	plastic bottle	2-6º C	no	NA	28 days

TABLE 1

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIME REQUIREMENTS (Continued)

Soil Gas

					Containers per Sample			Preservation Requirements			
Parameter	Matrix	Number of Samples (including Field QC)	Preparation Method	Analytical Method*	No.	Size	Type	Temp.	Light Sensitive	Chemical	Maximum Holding Time
TO-15	Air	Provided in project-specific QAPP	NA	EPA TO-15	1	3-Liter, 6-Liter	Summa Canister, Tedlar Bag	NA	No	NA	30 Days (Summa Canister), 48 hours (Tedlar Bag)

* Analytical Methods in accordance with NYSDEC ASP 2005.
* * VOC soil/sediment samples can be frozen. If this option is selected, the sample must be frozen within 48 hours of collection. The holding time recommences when thawing begins. The total holding time is calculated to freezing plus the time allowed for thawing. The total elapsed time must be less than 14 days.
* * * Sodium bisulfate preservation can lead to formation of acetone in samples containing high amount of humic material, and certain analytes, such as styrene, vinyl chloride, trichloroethene (TCE), may be decomposed by the bisulfate, leading to low- biased results. For carbonate rich soils effervescence may occur, which would result in significant losses of VOCs. In such cases, the sodium bisulfate cannot be used as a preservation method. Although use of this preservation technique is discouraged unless the limiting factors are known not to be present, preservation for low-concentration samples may be an acceptable option as long as the limitations are considered on a site-specific basis.

Acronym List:

AAS: Atomic Absorption Spectrometer
AES: Atomic Emission Spectrometry
GC: Gas Chromatography
GF: Graphite Furnace
HCL: Hydrochloric Acid
HPLC: High Performance Liquid Chromatography
ICP: Inductively Coupled Plasma
MeOH: Methanol
MS: Mass Spectrometry
N/A: Not Applicable
NaOH: Sodium Hydroxide
PCBs: Polychlorinated Biphenyls
VOCs: Volatile Organic Compounds

TABLE 2

SUMMARY OF PERIODIC LABORATORY CALIBRATION REQUIREMENTS

Instrument	Calibration Frequency	Acceptance Limits	Corrective Actions
Analytical Balances	Daily: Sensitivity (with a Class P weight)	0.001 g	Adjust sensitivity
	Monthly: Checked with Class S Weights	Standard deviation of <0.1 mg	Service balance
	Annually: Calibrated by outside vendor against certified Class S weights	0.001 g	Service balance
Thermometers	Annually: Calibrated against certified National Institute of Standards and Technology thermometers by outside vendor	± 0.5°C	Tag and remove from service
Automatic Pipettors	Quarterly: Gravimetric check	High volume (>100 mL): d1.0% relative error as relative standard deviation	Service or replace
		Low volume (<100 mL): d2.0% relative error as relative standard deviation	

TABLE 3

FIELD INSTRUMENTATION CALIBRATION FREQUENCY

Instrument	Frequency of Calibration Check	Calibration Standard
pH Meter	Prior to use – daily, and as needed in the field	Commercially prepared pH buffer solutions (4.01, 7.00, 10.00)
Conductivity Meter	Prior to use – daily, and as needed in the field	Commercially prepared saline solution (12.9 mS/cm)
Water-level Meter	Prior to initiating field work	100-ft engineer's tape
Dissolved Oxygen Meter	Per sampling event, and as needed in the field	Saturation
Photoionization Detector	Prior to use – daily, and as needed in the field	100 ppm isobutylene
Turbidity	Prior to use – daily, and as needed in the field	10 NTU, 200 NTU

Note: mS/cm = millisiemens per centimeter
ppm = parts per million
NTU = Nephelometric Turbidity Units

TABLE 4

FIELD MEASUREMENT QUALITY CONTROL OBJECTIVES

Field Parameter	Precision	Accuracy
Water Temperature	± 1°C	± 1°C (instrument capability)
pH	± 0.1 pH Standard Unit	± 0.1 pH Standard Unit (instrument capability)
Conductivity	± 1 mS/cm	±5% standard
Dissolved Oxygen	± 0.02 mg/L	±5%
Turbidity	± 1.0 NTU	±2% standard
Water Level	± 0.01 foot	±0.01 foot

Note: Precision units presented in applicable significant figures.
mS/cm = millisSiemens per centimeter
ppm = parts per million
mg/L = mg/liter
NTU = Nephelometric Turbidity Units

TABLE 5

PREVENTATIVE MAINTENANCE SUMMARY

Maintenance	Frequency
Conductivity, pH, Dissolved Oxygen Meters	
Store in protective casing	D
Inspect equipment before and after use	D
Clean probes	D
Keep logbook in instrument	D
Have replacement meter available	D
Replace probes	X
Return to manufacturer for service	X
Calibration	D
Turbidity Meter	
Store in protective casing	D
Inspect equipment before and after use	D
Clean sample cells	D and X
Clean lens	M and X
Check and recharge batteries	D
Keep logbook in instrument	D
Have replacement meter available	D
Return to manufacturer for service	X
Calibration	D
Thermometer	
Store in protective casing	D
Inspect equipment before and after use	D
Have replacement thermometer available	D
Water-level Meter	
Store in protective covering	D
Inspect equipment before and after use	D
Check indicators/batteries	D
Keep logbook on instrument	D
Have replacement meter available	D
Photoionization Detector	
Store in protective casing	D
Inspect equipment before and after use	D
Check and recharge batteries	D
Clean ultraviolet lamp and ion chamber	M and X
Keep logbook in instrument	D
Have replacement meter available	D
Return to manufacturer for service	X
Calibration	D

Note: D = Daily. M = Monthly. X = Operator’s discretion/as needed.

APPENDIX A

STANDARD OPERATING PROCEDURES for SAMPLE HANDLING and FIELD SCREENING

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Sample Handling

SOP #106

Revision Date: August 8, 2019

LIST OF REVISIONS

Date	Summary of Changes	Approval
	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

Technical Director/
Quality Assurance Officer

Gail L. Batchelder

Gail L. Batchelder, Ph.D., P.G., L.E.P.

August 8, 2019
Date

Vice President/
Practice Leader - Environmental:

Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

TABLE OF CONTENTS

ATTACHMENT

1.0 INTRODUCTION

This SOP identifies the containers, preservatives, sample preparation, chain-of-custody procedures, and QA/QC procedures associated with the various types of samples collected and analyzed by HRP.

Equipment:	This SOP deals primarily with methods requiring no equipment other than sample containers.
Documentation:	Field notebook and map or field work sheets to detail location of sampling points and relevant information related to sample collection. Chain-of-custody form for each sample delivery group.

2.0 CONTAINERS

2.1 Soils and Unconsolidated Materials

Samples of soil and other unconsolidated materials will be collected into wide-mouth glass jars with tightly fitting lids, or other appropriate container based on the analyses to be conducted. Specific information related to the appropriate container can be found in the project-specific Quality Assurance Project Plan (QAPP) and/or work plan. Sample containers to be submitted directly to the laboratory should be filled to the extent possible to eliminate any headspace and to ensure that sufficient sample is available for all analyses to be performed, although filling the jar completely is not required if that amount of soil is not needed to accomplish the project objectives for analyses to be performed.

However, for those samples for which analysis for volatile organic compounds (VOCs) will be conducted, EPA Method 5035A methods for sample collection and preservation will be used. Those methods are described in detail in HRP SOP #105 *Soil Sample Collection for VOC Analysis*. For such samples, 40-milliliter (ml) vials are obtained in advance from the laboratory filled with the appropriate amount of methanol and/or sodium bisulfate, and the vials are filled with the appropriate amount of soil specified by the SOP or the laboratory (if different).

2.2 Liquids

Several types of containers are available for liquid samples. The type(s) of container to be used are determined by the analyses to be performed and the nature and chemical properties of the liquid. Another factor that influences the type of container used for storage and transport of liquids is the sample volume requirements for the specific analyses to be performed. For example, oil samples may be contained in wide-mouth glass jars, similar to containers used for unconsolidated samples. Since samples collected for VOC analysis may undergo a loss of volatile constituents, vials used for water samples collected for subsequent VOC analysis must be fitted with Teflon™ septa and must be overfilled before closing to ensure that no headspace (air) is present in the vial. Other constituents may be subject to photochemical degradation and thus require collection into amber glass containers. Preservatives that must be used for liquid samples are specific to the nature and chemical properties of the specific analytes for which analysis is to be conducted. Information on sample collection requirements are provided in the QAPP and/or project-specific work plan.

2.3 Gasses

Gasses are intrinsically mobile and must be contained in fully-enclosed containers. The following types of container are available: Tedlar™ bags and glass bulbs with Teflon™ septa to allow insertion of hypodermic syringes. Summa® canisters are also typically used, especially for sub-slab soil vapor samples and indoor air samples that are used to evaluate vapor intrusion. Specifications for sample collection devices for gas samples should be selected based on data quality objectives for the project and will be specified in the project-specific QAPP and work plan.

3.0 PRESERVATION

Preservation requirements are provided in the QAPP and/or site-specific work plan that is developed for a project. Should there be any questions regarding preservation of samples, the analytical laboratory should be contacted or the most current update of EPA SW-846 should be consulted.

3.1 Refrigeration

Samples which do not require refrigeration are: oil samples; gaseous samples; and water samples to be analyzed only for metals. All other samples must be kept cool (ideally at 4°C ± 2°C) until delivery to the lab for analysis. Soil samples intended for VOC analysis should be preserved and otherwise managed in accordance with HRP SOP # 105.

Samples must not be allowed to freeze in cold weather. The jars/vials could break and the samples will be lost. Storage and transport containers and modes of transport must take the potential for freezing into account.

3.2 pH Adjustment and Other Preservatives

The pH of water samples should be adjusted in the field, as necessary, using the preservatives which are specified in the QAPP and/or site-specific work plan or the most recent SW-846 promulgated method for the requisite analytical parameter. Questions on preservatives should be directed to the analytical testing laboratory.

Gaseous samples do not require preservatives or pH-adjusting compounds to be added. In general, samples of unconsolidated material (soil, concrete, sediment) or sludge do not require the addition of a preservative. The exception is analysis for VOCs, in which case soil and sediment samples should be collected using EPA Method 5035A. These samples should be collected in vials pre-preserved with methanol and/or sodium bisulfate. The soil/preservative ratio should be indicated on the sampling container prior to sample collection or obtained directly from the testing laboratory. Additional detail on sample collection for subsequent VOC analysis is provided in HRP's SOP #105, as noted in Section 2.1.

3.3 Holding Times

Holding times for various parameters are specifically indicated in the most recent EPA SW-846 promulgated method for the requisite analytical parameter. Questions on holding times should be directed to the analytical laboratory. Additional information regarding sampling containers, preservation, and holding times will be made available in the QAPP and/or site-specific work plan.

4.0 SAMPLE COLLECTION AND PREPARATION

Samples will collected into appropriate, laboratory-supplied containers recommended for the media and analytical methods, as indicated in Section 2.0, and other relevant documents, such as the QAPP and site-specific work plan.

4.1 Filtration

Groundwater samples should not be filtered prior to analysis, except as allowed in accordance with regulatory guidance. The appropriateness of filtration for water samples and filter size is based on a number of factors, including objectives for the sampling effort, data quality objectives for the project, and regulatory considerations related to filtration of water samples. The need for filtration of groundwater samples must be discussed in the project-specific work plan, and the discussion must include the rationale for collection of filtered groundwater samples, as well as the procedures that would be used for collection of the filtered samples. Unless specifically indicated otherwise in a project-specific work plan (and the rationale for such a decision must be provided), an unfiltered sample should always be collected for analysis in addition to the filtered sample.

Whenever possible, an in-line filter should be used to filter groundwater samples as the water is withdrawn from the well. The selection of which, if any, filter should be used depends on the data quality objectives for the project and will be specified in the QAPP and/or site-specific work plan. A 0.45-micron filter is used for samples for which the objective is to obtain results for dissolved constituents (usually metals). A 10-micron filter is used to distinguish analytical results for dissolved plus colloidal constituents vs. analytical results that include constituents that might be absorbed onto fine-grained particles that are present in the water sample.

In some cases, water samples other than groundwater samples must be filtered in the field prior to sample collection into appropriate sampling bottles. To accomplish this, a sample of the water to be filtered is collected into a clean container with sufficient volume to fill all sampling containers for which a filtered sample is necessary. If electric power is unavailable, battery packs are required to operate the peristaltic pump. A ring stand with clamp to hold the in-line filter is optional but may be useful.

The procedure for filtration of water samples from a source other than a monitoring well is as follows:

- A sufficient length of new Tygon™ tubing (or tubing of other appropriate inert material) is inserted into a peristaltic pump.
- The input end of the tubing is then inserted into the unfiltered water sample, and an in-line filter (0.45-micron or 10-micron filter, as appropriate, depending on the objective for the sampling event) is inserted into the output end of the tubing.
- An additional length of tubing is connected to the other end of the in-line filter to better direct the filtered water into the sample bottle(s). The flow direction shown on the filter must match the actual flow direction.
- Once the in-line filter is placed over the sample container, the pump is then turned on and run until sample collection is complete.

As noted above for filtration of groundwater samples from monitoring wells, the selection of which, if any, filter should be used depends on the data quality objectives for the project and will be specified in the QAPP and/or site-specific work plan.

4.2 Compositing

Compositing of samples for investigation purposes is strongly discouraged. Therefore, compositing of soil or water should only be performed if specifically indicated in the project-specific work plan, and the specific rationale and approach to compositing should be clearly described in that document.

However, compositing of similar materials for the purposes of obtaining waste disposition approvals is generally acceptable, and often required. Careful consideration should be given to the objectives of the sampling before collection of any composite sample is performed.

Those soil samples to be analyzed for non-volatile parameters may be mixed in any convenient, clean container. Soil samples to be analyzed for volatile organic compounds should not be composited.

For waste oil and other wastes, only those of similar appearance (color, viscosity, suspended material, odor if determined) should be composited. Liquid samples may be composited by pouring the appropriate percentages into the sample container to be sent to the laboratory.

4.3 Chain-of-Custody Procedures

4.3.1 Chain-of-Custody Form

A copy of a representative chain-of-custody form is provided in Attachment A. The sampler must fill in all relevant information as indicated on the form, including the "laboratory preparation" section. Any preparation required should be indicated on the form. The sampler must sign the form in the space indicated, including data and time of transfer, when relinquishing samples to another individual or to the laboratory. Each successive handler of the samples must also sign the form with data and time when relinquishing samples, and the receiving entity must acknowledge receipt.

4.3.2 Sample Labeling Nomenclature

Samples shall be labeled with the following information:

- Date
- HRP
- HRP Job #
- Sample identification. Samples from test borings must have, in addition to the test boring identification, the depth from which the sample was retrieved.
- Special labeling requirements may also be required for certain jobs. These requirements should be detailed in the QAPP and/or project-specific work plan.

4.3.3 Delivery/Receipt Procedures

As noted above, the chain-of-custody forms must be signed by both the person delivering the samples and the person receiving them. The time and date of transfer must be indicated.

5.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

5.1 Blanks

Field, trip, and equipment blanks are slightly different from one another. For preparation of an equipment blank, an appropriate blank material (deionized water) is brought in contact with the pre-cleaned sampling tools used for "real" samples. Equipment blanks, in theory, indicate whether the sampling equipment has been properly decontaminated. Field blanks are prepared by carrying the blank material to the sampling site and placing it in appropriate containers. Field blanks are used to determine whether airborne contamination is present at the sampling site. Field blanks are collected only when airborne contamination is suspected. Trip blanks are prepared at the analytical laboratory and transported to the site in sealed containers. They are used to evaluate the potential for contamination that may be attributed to shipping and handling procedures. Temperature blanks are prepared prior to sampling. They document the temperature preservation of samples upon receipt at the laboratory.

Blank samples are typically used for quality control and quality assurance. They provide qualitative information concerning contamination, handling and shipping procedures which may affect the quality of data that is collected. The rate at which blank samples are collected depends on the DQOs established for the project, but are typically prepared at a rate of 5% (i.e., 1 per 20 samples). For VOC analyses, trip blanks are prepared at a rate of 1 per shipping container in which samples for VOC analysis are transported. In some cases, blank samples may be collected at a rate of 1 per day if less than 20 samples have been collected. A group of samples that are transported together generally constitutes the sample delivery group (SDG). Specific requirements for collection of blank samples should be provided in the project-specific QAPP and work plan.

Water: Water for blanks shall consist of analyte-free water. The blank sample should be collected in the same kind of container used for the other water samples. Blank samples should be given plausible "well" identifications such as "MW-28". Trip blanks are typically analyzed only for VOCs. Analysis of equipment and field blanks are generally determined on a site-by-site basis or as specified in a site-specific work plan or QAPP.

Soil: Due to difficulties in preparing representative samples, blanks comprised of soil are uncommon.

5.2 Duplicates

True duplicates of samples cannot really be obtained, but replicate samples (which are commonly referred to as “duplicates”) should be collected as near as possible, both in time as well as space, to their principal samples. Depending on project objectives, sampling identification may indicate to the laboratory that the sample is a duplicate of another sample or the sample may be submitted to the laboratory as a “blind duplicate,” i.e., with no indication in the sample identifier that the sample is a duplicate or replicate of another sample.

Information regarding the collection of duplicate samples will be specified in the QAPP and/or project-specific work plan.

6.0 REFERENCES

New York State Department of Environmental Conservation (NYSDEC). 2010. *DER-10, Technical Guidance for Site Investigation and Remediation*, Division of Environmental Remediation. May 2010.

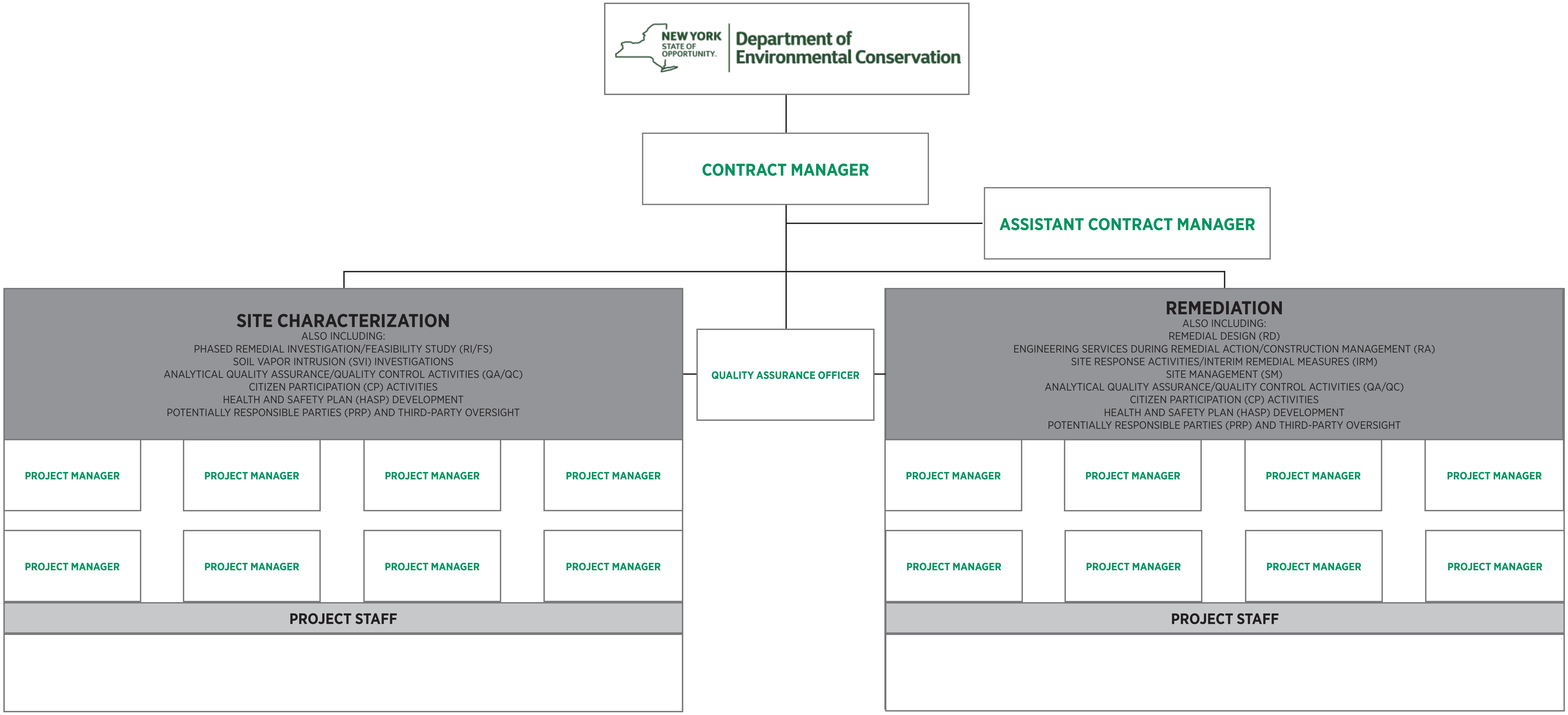
NYSDEC, Technical Procedure Guidance, Quality Assurance/Quality Control Procedures, *Spill Guidance Manual*, Section 2.4.

USEPA. 2015*. Standard Operating Procedure - Sample Receiving, Handling, and Storage,* SERAS SOP No. 1008, Rev. 2.1, Scientific, Engineering, Response and Analytical Services, December 9, 2015*.*

FIGURE

FIGURE 1

REPRESENTATIVE ORGANIZATION CHART



NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

CONTRACT MANAGER

ASSISTANT CONTRACT MANAGER

QUALITY ASSURANCE OFFICER

SITE CHARACTERIZATION

ALSO INCLUDING:
PHASED REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)
SOIL VAPOR INTRUSION (SVI) INVESTIGATIONS
ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES (QA/QC)
CITIZEN PARTICIPATION (CP) ACTIVITIES
HEALTH AND SAFETY PLAN (HASP) DEVELOPMENT
POTENTIALLY RESPONSIBLE PARTIES (PRP) AND THIRD-PARTY OVERSIGHT

PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER

PROJECT STAFF

REMEDIATION

ALSO INCLUDING:
REMEDIAL DESIGN (RD)
ENGINEERING SERVICES DURING REMEDIAL ACTION/CONSTRUCTION MANAGEMENT (RA)
SITE RESPONSE ACTIVITIES/INTERIM REMEDIAL MEASURES (IRM)
SITE MANAGEMENT (SM)
ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES (QA/QC)
CITIZEN PARTICIPATION (CP) ACTIVITIES
HEALTH AND SAFETY PLAN (HASP) DEVELOPMENT
POTENTIALLY RESPONSIBLE PARTIES (PRP) AND THIRD-PARTY OVERSIGHT

PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER
PROJECT MANAGER

PROJECT STAFF

ATTACHMENT A

Representative Chain-of-Custody Form

con-test ANALYTICAL LABORATORY

Phone: 413-525-2332
Fax: 413-525-6405
Email: info@contestlabs.com

http://www.contestlabs.com

CHAIN OF CUSTODY RECORD

Doc # 381 Rev 1_03242017

39 Spruce Street
East Longmeadow, MA 01028

Page _____ of _____

Company Name:
Address:
Phone:
Project Name:
Project Location:
Project Number:
Project Manager:
Con-Test Quote Name/Number:
Invoice Recipient:
Sampled By:

Requested Turnaround Time
7-Day ☐ 10-Day ☐
Due Date:

Rush-Approval Required
1-Day ☐ 3-Day ☐
2-Day ☐ 4-Day ☐

Data Delivery
Format: PDF ☐ EXCEL ☐
Other:
CLP Like Data Pkg Required: ☐
Email To:
Fax To #:

# of Containers
[2] Preservation Code
[3] Container Code

ANALYSIS REQUESTED

Dissolved Metals Samples
○ Field Filtered
○ Lab to Filter

Orthophosphate Samples
○ Field Filtered
○ Lab to Filter

Con-Test Work Order#	Client Sample ID / Description	Beginning Date/Time	Ending Date/Time	Composite	Grab	[1]Matrix Code	Conc Code

Comments:

Please use the following codes to indicate possible sample concentration within the **Conc Code** column above:
H - High; M - Medium; L - Low; C - Clean; U - Unknown

[1] **Matrix Codes:**
GW = Ground Water
WW = Waste Water
DW = Drinking Water
A = Air
S = Soil
SL = Sludge
SOL = Solid
O = Other (please define)

[2] **Preservation Codes:**
I = Iced
H = HCL
M = Methanol
N = Nitric Acid
S = Sulfuric Acid
B = Sodium Bisulfate
X = Sodium Hydroxide
T = Sodium Thiosulfate
O = Other (please define)

[3] **Container Codes:**
A = Amber Glass
G = Glass
P = Plastic
ST = Sterile
V = Vial
S = Summa Canister
T = Tedlar Bag
O = Other (please define)

Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:
Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:
Relinquished by: (signature)	Date/Time:
Received by: (signature)	Date/Time:

Detection Limit Requirements
MA
CT
Other:

Special Requirements
☐ MA MCP Required
MCP Certification Form Required
☐ CT RCP Required
RCP Certification Form Required
☐ MA State DW Required
PWSID #

con-test ANALYTICAL LABORATORY
www.contestlabs.com

NELAC and AIHA-LAP, LLC Accredited

Project Entity
☐ Government ☐ Municipality ☐ MWRA ☐ WRTA
☐ Federal ☐ 21 J ☐ School
☐ City ☐ Brownfield ☐ MBTA

Other
☐ Chromatogram
☐ *AIHA-LAP,LLC*

PCB ONLY
☐ Soxhlet
☐ Non Soxhlet

Recommended Containers, Preservation, Storage, & Holding Times For Water, Drinking Water, and Wastewater

Description	Method	Matrix	Sample container	Preservative	Prep/Analysis Holding Time	Volume
Organic Analyses						
EDB, DBCP	504.1	H_2O	40ml Vial Teflon septa	Cool 4^{0}C $Na_2S_2O_3$	14 days	40 ml
GCMS - Volatiles	524.2	H_2O	40ml Vial Teflon septa	Cool 4^{0}C Ascorbic acid & HCL to pH<2	14 days	40 ml
	624, 8260	H_2O	40ml Vial Teflon septa	Cool 4^{0}C HCL to pH<2	14 days	40 ml
GC-Pesticides & PCBs	608	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C NaOH or H_2SO_4 to pH 5-9	7/40 days	1 Liter
GC-Pesticides & PCBs	8081, 8082	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
GC/MS-Semivolatiles - PAH's Base Neutral/Acid Extractables	625, 8270	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
Petroleum Hydrocarbons						
Oil & Grease	1664	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C H_2SO_4 to pH<2	28 days	1 Liter
Diesel Range Organics (DRO)	Modified 8015B	H_2O	Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
Gasoline Range Organics (GRO)	Modified 8015B	H_2O	Glass Teflon Cap	Cool 4^{0}C HCL to pH<2	14 days	40 ml
Total Petroleum Hydrocarbons (TPH) by GC	Modified 8100	H_2O	Glass Teflon Cap	Cool 4^{0}C	7/40 days	1 Liter
MA DEP VPH	98-1	H_2O	40ml Vial Teflon septa	Cool 4^{0}C 3-4 drops of 1:1HCL	14 days	40 ml
MA DEP EPH	97-12	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C 5 ml of 1:1HCL	14/40 days	1 Liter
CT ETPH	CT ETPH	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C	14/40 days	1 Liter
Metals						
ICP/ICPMS Metals	200.7/200.8 6010/6020	H_2O	Plastic / Glass	Cool 4^{0}C HNO_3 to pH<2	6 months	DW-1L WW-250ml
Mercury (Hg)	245.1/7470A	H_2O	Plastic / Glass	Cool 4^{0}C HNO_3 to pH<2	28 days	DW-1L WW-250ml
Chromium VI (Cr^{+6})	SM 3500 Cr D	H_2O	Plastic / Glass	Cool 4^{0}C	24 hours	200 ml
Chromium VI (Cr^{+6})	SW-846 7196A	H_2O	Plastic / Glass *	Cool 4^{0}C	24 hours	200 ml
Inorganic/Wet Chemistry						
Alkalinity	SM 2320B	H_2O	Plastic / Glass *	No Headspace Cool 4^{0}C	14 days	250 ml
BOD	SM 5210B	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	1 Liter
Chloride	SM 4500 Cl B	H_2O	Plastic / Glass	Not Required	28 days	250 ml
Chlorine, Total Residual	SM4500 Cl G	H_2O	Plastic / Glass	Not Required	Analyze immediately	250 ml
COD	410.4/Hach 8000	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	250 ml
Coliform, Fecal	SM 9222D	H_2O	Sterile Plastic	Cool 4^{0}C	6 hours	100 ml
Coliform, Total	SM 9222B	H_2O	Sterile Plastic	Cool 4^{0}C	30 hours	100 ml
E. Coli confirmation	SM 9222G	H_2O	Sterile Plastic	Cool 4^{0}C	30 hours	100 ml
Heterotropic Plate Count	SM 9215B	H_2O	Sterile Plastic	Cool 4^{0}C	8 hours	100 ml

Description	Method	Matrix	Sample container	Preservative	Prep/Analysis Holding Time	Volume
Inorganic/Wet Chemistry (continued)						
Color	SM 2120B	H_2O	Sterile Plastic	Cool 4^{0}C	48 hours	200 ml
Conductance	SM 2510B	H_2O	Plastic / Glass	Cool 4^{0}C	28 days	100 ml
Cyanide, Amenable	SM4500 Cn-C,E	H_2O	Amber Glass	Cool 4^{0}C NaOH to pH>12	14 days	500 ml
Cyanide, Free	SM4500 Cn-C,E	H_2O	Plastic / Glass	Cool 4^{0}C NaOH to pH>12	14 days	500 ml
Cyanide, Total	SM4500 Cn-C,E	H_2O	Plastic / Glass	Cool 4^{0}C NaOH to pH>12	14 days	500 ml
Flashpoint	SW 846 1010	H_2O	Plastic / Glass	Cool 4^{0}C	ASAP	50 ml
Flouride (drinking water)	SM 4500F-C	H_2O	Plastic / Glass	Not Required	28 days	200 ml
Hardness	SM 2340C	H_2O	Plastic / Glass	Cool 4^{0}C	6 months	250 ml
MBAS (Surfactants)	SM5540C	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	250 ml
Nitrogen, Ammonia	SM 4500 NH3C	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	250 ml
Nitrogen, Total Kjeldahl	SM 4500-N Org B, C,	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	500 ml
Nitrogen, Nitrate	SM 4500 NO3 F	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	48 hours / 28 days preserved	250 ml
Nitrogen, Nitrite	SM 4500 NO2 B	H_2O	Plastic / Glass	Cool 4^0 C	48 hours	100 ml
Nitrogen, Nitrate + Nitrite	SM 4500 NO3 F	H_2O	Plastic / Glass	Cool 4^0 C H_2SO_4 to pH<2	48 hours / 28 days preserved	100 ml
Odor	SM 2150B	H_2O	Plastic / Glass	Cool 4^{0}C	24 hours	500 ml
Orthophosphate	SM 4500 P E	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	100 ml
Oxygen, Dissolved	SM 4500 O-C1 SM S210B	H_2O	Plastic / Glass with glass top	Cool 4^{0}C	Analyze immediately	300 ml
pH, Hydrogen ion	SM 4500 H-B	H_2O	Plastic / Glass	Not Required	Analyze immediately	25 ml
Phenolics	420.1	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	1 Liter
Phosphorous, Total	SM4500P-E	H_2O	Plastic / Glass	Cool 4^{0}C H_2SO_4 to pH<2	28 days	500 ml
Total Dissolved Solids (TDS)	SM 2540C	H_2O	Plastic / Glass	Cool 4^{0}C	7 days	300 ml
Total Suspended Solids (TSS)	SM 2540D	H_2O	Plastic / Glass	Cool 4^{0}C	7 days	300 ml
Settleable Solids	SM 2540 F	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	1 Liter
Sulfate	ASTM DS16-90	H_2O	Plastic / Glass	Cool 4^{0}C	28 days	300 ml
Sulfide	SM 4500 S2,E	H_2O	Plastic / Glass with Glass top	Cool 4^{0}C NaOH to pH>9 2N Zn Acetate	Analyze immediately	500 ml
Sulfite	377.1 / SM 4500 SO3	H_2O	Plastic / Glass	Not Required	Analyze immediately	100 ml
Total Organic Carbon (TOC)	SM S310B	H_2O	Amber Glass Teflon Cap	Cool 4^{0}C HCL to pH<2	28 days	100 ml
Turbidity	180.1 / SM 2130 B	H_2O	Plastic / Glass	Cool 4^{0}C	48 hours	100 ml

Recommended Containers, Preservation, Storage, & Holding Times For Soil, Solids, and Other Wastes

Description	Method	Matrix	Sample container	Preservative	Prep/Analysis Holding Time	Volume
Organic Analyses						
GCMS - Volatiles	8260B	Soil/Waste	Glass w/ Teflon Septa	Cool 4^{0}C 15 ml CH_3OH or 5 ml NaHSO4 5 or ml DI H_2O	14 days	15g or 5g or 5g
GC-Pestacides & PCBs	8081A/8082	Soil/Waste	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
GC/MS-Semivolatiles - PAH's Base Neutral/Acid Extractables	8270C	Soil/Waste	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
Petroleum Hydrocarbons						
Diesel Range Organics (DRO)	Modified 8015B	Soil	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
Gasoline Range Organics (GRO)	Modified 8015B	Soil	Glass w/ Teflon Septa	Cool 4^{0}C 15 ml CH_3OH	14 days	15 grams
Total Petroleum Hydrocarbons (TPH) by GC	Modified 8100	Soil	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
MA DEP VPH	98-1	Soil	40ml Vial Teflon septa	Cool 4^{0}C 15 ml CH_3OH	14 days	15 grams
MA DEP EPH	97-12	Soil	Amber Glass Teflon Cap	Cool 4^{0}C	14/40 days	100 g or 8oz Jar
CT ETPH	CT ETPH	Soil	Glass w/ Teflon Septa	Cool 4^{0}C	14/40 days	100 g or 8oz Jar

Description	Method	Matrix	Sample container	Preservative	Prep/Analysis Holding Time	Volume
Metals						
ICP Metals	6010	Soil	Plastic / Glass	Cool 4^{0}C	6 months	100 g or 8oz Jar
Chromium VI (Cr^{+6})	SW-846 7196A	Soil	Plastic / Glass *	Cool 4^{0}C	24 hours	(2) - 2oz Jars
Mercury (Hg)	7471	Soil	Plastic / Glass	Cool 4^{0}C	28 days	100 g or 8oz Jar
Inorganic/Wet Chemistry						
General Inorganics	9000 Series	Soil	Glass Teflon Cap	Cool 4^{0}C	See Table 1.	100 g or 8oz Jar
Flashpoint/Ignitibility	1010	Soil	Glass Teflon Cap	Cool 4^{0}C	ASAP	100 g or 8oz Jar
pH/Corrosivity	9045C	Soil/Waste	Plastic / Glass	Cool 4^{0}C	ASAP	100 g or 2oz Jar
Reactivity	SW 846 (7.3)	Soil/Waste	Plastic / Glass	Cool 4^{0}C	ASAP	100 g or 8oz Jar
TCLP/SPLP	1311/1312	Soil/Waste	Glass Teflon Cap	Cool 4^{0}C	Varied	500g or 32 oz Jar
TCLP/SPLP	1311/1312	Soil/Waste	Glass Teflon Cap	Cool 4^{0}C	Varied	500g or 32 oz Jar

* Requires it's own container

con-test®
ANALYTICAL LABORATORY

Revised 04.05.10

HRP Associates, Inc.

STANDARD OPERATING PROCEDURE
for

Field Screening

SOP #108

Revision Date: August 8, 2019

LIST OF REVISIONS

Date	Summary of Changes	Approval
	Original document preparation	
8/2019	Multiple revisions throughout document	Gail L. Batchelder, Ph.D.

Reviewed by:

Technical Director/
HRP Quality Assurance Officer

Gail L. Batchelder
Gail L. Batchelder, Ph.D., P.G., L.E.P.

August 8, 2019
Date

Vice President/
Practice Leader - Environmental

Scot Kuhn, P.G., L.E.P.

August 8, 2019
Date

TABLE OF CONTENTS

1.0 INTRODUCTION

This SOP identifies the general procedures to be used for screening of soil and water samples during the performance of field activities. Field-screening procedures include use of tool, instrument, or technique that results in the collection of real-time or near real-time environmental data.

Equipment:	Equipment used for field screening varies by the type of screening to be performed. The types of equipment needed for each field screening technique are identified in the specific sections of this SOP associated with the individual types of field screening procedures.
Documentation:	Field notebook, map, and/or field work sheets, including geologic boring logs, to detail location of sampling points and relevant information related to sample collection and field screening measurements.

This SOP has been prepared to describe standard procedures that will be used in most cases during the performance of field screening activities. However, nothing in this standard operating procedure is intended to preclude the application of sound professional judgement during the performance of field activities. Should situations arise that require alternative procedures to those described herein in order to accomplish overall project objectives or to meet data quality objectives, field personnel should document the rationale for changes to the standard procedures in the field paperwork and describes the procedures that were followed instead. In some cases, the need for changes to standard protocols may be recognized ahead of time, in which case, the procedures to be followed should be described in project-specific work plans or work instructions.

Similarly, the procedures described herein are not intended to conflict with any specific federal, state, or local statutes, regulations, guidance, protocols, or specific instructions of a regulatory authority. If changes to the SOP are needed, such changes should be identified in project-specific work plans or other similar document that will be maintained in the project record.

2.0 FIELD SCREENING PHYSICAL METHODS

2.1 Visual Observations

Visual observations of samples being collected during environmental investigations can be an important tool in understanding the hydrogeology and/or geochemistry at and in the vicinity of the location where the sample was collected and provide useful information for development of the conceptual site model and selection of individual samples for subsequent laboratory analysis. Therefore, detailed descriptions of soil and water characteristics are considered to be an important component of field screening procedures.

For soil, observations should include such characteristics as color, texture and grain-size distribution, relative moisture content, and relative density. Characterization of soil samples should be recorded in the field on geologic boring logs for soil samples collected from soil borings. Descriptions of soil samples for other collection methods should be recorded on appropriate field paperwork designated for that purpose.

Visual observations should be in accordance with one or more standard protocols for visual identification of soil samples based on grain-size distribution and physical characteristics of the soil sample. Specifically, soil descriptions and classifications should be performed in accordance with ASTM Standard D2488-17, *Practice for Description and Identification of Soils (Visual-Manual Procedure)* and ASTM Standard D2487-17*, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System),* and/or HRP's SOP #103 *Soil Logging Using a Modified Burmister Classification System,* as appropriate based on the data quality objectives for the project and any regulatory requirements or guidance.

For water, the sampler should record such observations as color; turbidity; and amount, nature, and color of any suspended material as settling occurs. If a sheen or separate-phase non-aqueous-phase liquid (NAPL) is observed, that should be noted, and the nature of the observation with respect to color, general appearance, and density relative to the water sample (i.e., whether the separate-phase accumulates at the top of a container of the water or at the bottom), which would indicate whether the separate-phase liquid is light NAPL (LNAPL) or dense NAPL (DNAPL).

2.2 Olfactory Observation

Olfactory observations should be noted only if odors are evident in ambient air conditions. Under <u>no</u> circumstances are personnel allowed to directly smell samples from containers. Only if the nature of the odor is clearly recognizable as attributable to a certain type of chemical (such as petroleum product or chlorinated solvent, for example), is it permissible to record that aspect of the olfactory observation on the field boring log or in field notes.

3.0 NON-AQUEOUS-PHASE LIQUID (NAPL) DETERMINATION KITS (SOILS)

Where NAPL is suspected based upon historical site knowledge or elevated screening levels for volatile organic compounds, project-specific DQOs for data collection may include an evaluation of the presence NAPL in the field. Commercial NAPL detection/screening products will be used by HRP personnel. In all cases, manufacturer's instructions will be followed. Non-Sudan IV based dyes will be preferentially selected as a non-toxic, hydrophobic indicator of the presence NAPL. Sudan IV based dyes should not be selected unless specifically required by a state of federal agency, due to the recent determination that Sudan IV dye is a mutagen. The limitations of the specific products selected should be well understood prior to use, and it should be recognized that any product is more likely to yield a false-negative result than a false-positive result, so information gained during field screening for the presence of NAPL must be reviewed in conjunction with other data available for each sample and for the investigation area as a whole.

Personal protective equipment (PPE) should be donned and maintained in accordance with the site-specific work plan and/or health and safety plan during the sampling and screening procedures. In the event that no PPE has been specified for a particular sampling event, disposable latex gloves should be donned, at a minimum, during all sampling procedures. Gloves must be changed after each individual sample collection event.

Sampling/screening equipment will be largely determined by manufacturer's instructions. Commercial test kits may consist of pre-measured dye packets that are enclosed in clean sampling cups. Specified quantities of soils are emplaced in the sampling cups, taking care not to disturb the dye package. Clean tap water is then added to the container. The container is sealed and shaken vigorously. If NAPL is present at a concentration generally greater than 500 ppm, it will separate from the soils and change color. The color of the NAPL will be dependent on the test kit selected. The sampling kits and soils should be containerized and properly disposed.

4.0 FIELD INSTRUMENT SCREENING

4.1 Photoionization Detector (PID)

PIDs are used during the performance of field activities for general screening of soil, water, or air for the presence of volatile organic compounds (VOCs). The instrument is used only to screen for the presence of total concentrations of VOCs, not for the presence of individual constituents, and not all constituents of interest may be detected by the instrument.

PIDs can only monitor air quality, and no water/soil should be introduced into sample line. This method has limited use in high humidity or in the presence of methane or other compounds that have high ionization potentials. However, performance may be improved by using a vapor trap in PID models that may be equipped with one.

Users should refer to the operation manual for the instrument being used to ensure that electron voltage for the bulb used is appropriate for compounds to be detected. Halogenated alkanes, such as 1,1,1-trichloroethane, or higher molecular weight aromatic compounds traditionally use a higher electron volt bulbs (11.7 ev) due to the increased strength of bonding force of these chemicals. For general screening of matrices, use a 10.6 electron volt bulb as an "all purpose" bulb; but a predetermination of compounds to be detected is helpful before making this decision. Generally, straight-chain hydrocarbon carbons are not ionizable using a PID, and therefore, the presence of those compounds will not be detected by the instrument.

4.1.1 Specific Equipment List

- Photoionization detector
- Sealable plastic/polyethylene bags
- Personal protection equipment
- Calibration gas

4.1.2 Documentation

- Site plan
- Activity log/sample log
- Notebook – sketch pad

4.1.3 Procedure

Following calibration of instrument:

1. Record background reading.
2. Place a small quantity of matrix to be tested into a sealable plastic/polyethylene bag.
3. Let matrix warm to room temperature.
4. Insert probe tip into bag (do not insert probe into matrix).
5. Record reading.

Samples that are wet may give a false positive reading. This effect is present when readings gradually increase with no discernable leveling off. If this effect is observed, the instrument bulb should be cleaned, and the instrument recalibrated, prior to re-testing the sample. If the response persists, the screening results should be noted as suspect. However, to help minimize the effect of moisture on screening results, some PID models may be equipped with a moisture trap to remove at least some of the moisture as the air enters the instrument.

For air monitoring purposes one can either wear the monitor with straps or have monitor in the exclusion zone close and at the breathing zone level. Instrument readings will be recorded through time at intervals specified in the health and safety plan.

For water samples, place approximately 10 milliliters (ml) of water in a non-preserved glass 40 ml VOA vial. Shake vigorously and allow to settle. Open vial and tip cap slightly sideways to allow entrance of instrument probe. Do not insert probe into water, as the instrument pump will draw water into the sample line and to the bulb, which will ruin the instrument and bulb.

4.2 Gas Chromatograph

4.2.1 Specific Equipment List

- Portable gas chromatograph with a pre-column, backflush oven, and PID detector
- Ultra-zero air
- Water standards/blanks
- Syringes

4.2.2 Documentation

- Site plan
- Activity log
- Organic vapor headspace form
- Notebook – sketch pad

4.2.3 Procedure

A portable gas chromatograph with a pre-column, backflush oven, and PID/FID detector is used to analyze the “headspace gas” obtained from each soil sample. The peak amplitudes and retention times obtained from each sample are compared to standard peaks and retention times obtained from prepared in-house standards from a suite of volatile organic compounds expected, or likely, to be present in the media sampled. Based on a comparison of the sample results with the standards, the amounts and types of contaminants in each sample are determined.

The headspace screening is performed on-site in a mobile trailer laboratory, a support vehicle, or in a designated location in a site building. This is an initial semi-quantitative “headspace” screening only and is not a state-certified laboratory analysis performed using standard EPA methods.

“Ultra-zero air” certified to contain less than 0.1 parts per million (ppm) total hydrocarbons is used as the carrier gas. The gas chromatograph’s oven runs isothermally at 40ºC. The total run time for each sample is sufficient to allow analysis of the targeted volatile organics. Both sample and standard injection volumes are recorded to allow direct quantification between standards and unknowns. The carrier gas flow rate is also held constant at approximately 10 cubic centimeters (cc)/minute to assure constant retention times.

During the screening, a Quality Assurance/Quality Control (QA/QC) program is followed. The purpose of the QA/QC program is to assure that any soil contamination detected in the soil samples did not arise from interferences and to provide semi-quantitative basis for sample evaluation.

The QA/QC program consists of a periodic injection of "headspace" gas obtained from water standards and analysis of "blanks". Calibration standards of specific compounds and a range of concentrations for certain targeted volatile organic compounds will be obtained from a state-certified laboratory or prepared by HRP (determined on a site-specific basis). These standards are injected into the GC, and results for the targeted compounds are then stored in the GC's "memory" prior to sample collection. Various "blank" analyses were performed to evaluate potential avenues of cross-contamination.

"Blank" analyses consist of:

1. Instrument blanks (no injection) to check the potential for column carry-over and "ultra-zero air" cleanliness;
2. Syringe blanks to check the potential for needle carry-over;
3. Soil sample container blanks to determine container cleanliness (although sample containers are pre-tested for contaminants under a QA/QC program which is completed by the manufacturer of the containers); and
4. Ambient "background" air blanks in both the sample collection and instrument areas to check the potential for cross-contamination from airborne contaminant sources.

All chromatograms are stored on a computer library and are later downloaded to a hard copy. Peak areas are integrated by the GC's computer by comparison with standards pre-programmed into the library. Preparations containing selected potential site contaminants are generally injected into the GC to "check" retention times on a twice daily basis.

The objectives of the QA/QC program are achieved on the sampling dates when:

1. GC column carry-over is not found to be significantly interfering with any of the analyses;
2. Carry-over syringe contamination is not detected after any sample injection;
3. No interference due to volatile organic contamination is detected in any container blanks (e.g. 40 ml VOA septa soil sampling jar);
4. Ambient air in the sample analysis area and outside the building is not found to be significantly interfering with the soil sample screening results; and
5. The "ultra-zero air" used in the gas chromatograph has no contaminants present before testing.

4.3 Specific Conductance, pH, Dissolved Oxygen, Oxidation/reduction Potential

Screening-level measurements of the standard water-quality parameters of specific conductance, pH, dissolved oxygen (DO), and oxidation/reduction potential (ORP), may be made using stand-alone instruments specific to the parameter being measured, or by combination instruments that measure one or more of the parameters at the same time. The most common type of combination measurement technique currently used is a flow-through cell that is used in conjunction with low-flow groundwater sampling techniques. When using a flow-through cell, measurements are made using specific electrodes within a closed cell as groundwater is pumped from a well at a low flow rate moves through the cell. In contrast, most stand-alone meters require that separate aliquots of water be collected into a container that is exposed to the atmosphere as the electrodes equilibrate in the solution and measurements are recorded.

Although the equipment varies depending on the instrument(s) used, documentation is the same for all types or combinations of instruments. Documentation needs include the following:

- Activity Report
- Notebook
- Monitor Well Data Sheet or field sampling log (for water samples other than groundwater).

In all cases, instruments should be used, calibrated, and maintained in accordance with manufacturer’s instructions. Information provided in the following sub-sections is provided as an overview of information related to measurement of specific parameters. Additional, more detailed information can found in the operating manuals for the specific equipment and in the references provided in Section 7.0 of this SOP.

4.3.1 Specific Conductance

Conductivity/salinity meters are used to determine the electrical conductance and salinity of water/wastewater. Values are generally expressed in µmhos/cm or µS/cm (µSiemens/cm).

4.3.1.1. Specific Equipment List

- Instrumentation for measurement of specific conductance (e.g., conductivity/salinity meter, hand-held conductivity meter)
- Calibration solution

4.3.1.2. Procedure

Calibration of the instrument must be performed prior to measurement of specific conductance for individual samples. All calibration procedures and measurements of specific conductance for samples will be conducted in accordance with manufacturer’s instructions for the specific instrument being used. Specific conductance readings are affected by temperature, so it is important that the instrument settings are adjusted to take the temperature into account or to ensure that the specific conductance meter uses an automatic temperature compensator.

4.3.2 pH

The pH meter is used for determining the acidity of water and wastewater as expressed in pH units.

4.3.2.1. Specific Equipment List

- Instrumentation used to measure pH (may be a combination meter that measures other parameters or may be a stand-alone, hand-held pH meter).
- Standard pH calibration solutions (pH 4.0, pH 7.0, pH 10.)

4.3.2.2. Procedure

Following calibration procedures, immerse end of probe into liquid sample (an aliquot of sample not used for laboratory analysis). Allow probe to acclimate to sample. Meter will provide digital read-out of pH in standard pH units.

4.3.3 Dissolved Oxygen Meter

The dissolved oxygen (DO) meter is used for determining the dissolved oxygen content in milligrams per liter.

4.3.3.1. Specific Equipment List

- DO Meter
- Potassium chloride (KCl) solution
- Probe membranes

4.3.3.2. Procedure

Following calibration procedures, immerse end of probe into liquid sample (aliquot of sample not used for laboratory analysis). Allow probe to acclimate to sample. Meter will provide a digital read-out in mg/l or %. The probe should be slowly raised and lowered while remaining completely submersed in the sample in order to obtain an accurate reading.

4.3.4 Oxidation/reduction Potential

An oxidation/reduction potential measurement indicates the difference in electric potential between an indicator electrode and an appropriate reference electrode. Oxidation/reduction potential is a useful indicator of the equilibrium oxidation state of a chemical species in the water sample being tested, particularly when evaluated in conjunction with the pH of the solution. ORP is reported in millivolts (mV).

4.3.4.1. Specific Equipment List

- Instrumentation for measurement of ORP (meter, indicator electrode, reference electrode)
- Calibration solution (Zobell solution)

4.3.4.2. Procedure

ORP is temperature dependent, so the meter should have automatic temperature compensation and the probe must be allowed to equilibrate to the ambient temperature of the solution before the measurement is recorded (calibration solution must be at ambient temperature), or a separate temperature measurement must be made and the value measured by the instrument must be corrected based on the recorded temperature of the solution.

In some cases, the instruction manual will indicate that the instrument is calibrated at the factory. If so, the Zobell solution should be used to verify the factory calibration. If the two measurements do not agree, the first step is to use a new Zobell solution. If the measured value still does not agree with the value for the Zobell calibration solution, the instrument will need to be recalibrated by the manufacturer.

4.4 Turbidity

Instruments that measure turbidity measure the difference between the intensity of light scattered by a liquid sample, generally water, compared to the intensity of light scattered by a standard reference suspension. Turbidity measurements indicate the amount of suspended or colloidal material in a water sample, and results may be affected by the color of the water sample. A turbidity meter (turbidimeter) provides results in nephelometric turbidity units (NTUs).

4.4.1 Specific Equipment List

- Turbidimeter
- Calibration solution (for example, a commercially available polymer primary standards (AMCO-AEPA-1)

4.4.2 Procedure

The calibration standard (or standards if the instrument uses more than one standard) should be allowed to equilibrate to the ambient temperature. Initially, a standard with a low turbidity value (0.0 or 0.02 NTU) should be used to calibrate the instrument in accordance with the manufacturer’s instructions. A 0 NTU standard solution can be prepared by filtering distilled water through a 0.45-micron filter. The instrument should read the standard value to within the specifications of the instrument. If the instrument accepts more than one standard, at least one additional standard at a relatively high turbidity value should be used. If the instrument accepts only one standard, the higher standard should be used as a check standard for the instrument to ensure that the instrument identifies the value of the check standard within the specifications of the instrument.

An important consideration when using a turbidimeter is ensuring that the cuvettes in which the water samples and calibration solution are placed for measurement are free from scratches and that the outside surface are dry and the clarity is not affected by such things as fingerprints or dust. If the cuvette cannot be cleaned, it should be discarded. Therefore, it is important to have a number of cuvettes available for each sampling event.

5.0 EQUIPMENT CALIBRATION METHODS

All field equipment will be calibrated immediately prior to use in the field. The calibration procedures will follow standard manufacturer's instructions or routine HRP procedures to assure that the equipment is functioning within tolerances established by the manufacturer and required by the project. Field personnel will document all instrument calibrations in bound field notebooks and on specific calibration forms. All records generated will be maintained by field personnel and are subject to audit by the Task or Project Manager.

The detailed calibration, operation, and maintenance procedures for field instrumentation routinely used by HRP personnel are specific to manufacturer's instructions. The following sections will briefly summarize these procedures.

Calibration standards and pH buffer solutions used for field instrumentation calibration checks will be obtained from scientific products supply companies (e.g., Fisher Scientific; American Scientific Products, etc.). All buffer and calibration standards obtained will be certified and standardized against or traceable to a reliable primary reference standard. All solutions are stored according to manufacturer's suggestion for optimal shelf-life. Chemical container labels must also include the date received, date opened, as well as the initials of the analyst who first opened the container. Stock solutions will be marked with expiration date and replaced with new solutions when the recommended shelf-life is exceeded.

5.1 Photoionization Detector (PID)

HRP uses several types of PIDs made by different manufacturers. Calibration procedures which are specific to each instrument can be found in the manufacturer's operation manual. The PIDs will be calibrated in the field, under the working temperature conditions where it is to be used. The calibration gas typically used is isobutylene at a concentration of 100 ppm. Calibrations should be recorded in the field notebook and on the calibration log of the Health and Safety Plan. Calibration records should note the date, instrument manufacturer and model, calibration gas and concentration, and operator.

5.2 Temperature/Conductance Meter

Calibration is performed at the start of each sampling day using potassium chloride (KCl) standard solutions. Calibrations are recorded in either a bound field notebook or on field calibration forms. Specific conductance standards are selected to bracket the range of values expected in the samples. If the unit has a calibration adjustment, the meter is calibrated in the same manner as the pH meter. Internal automatic adjustments are made on meters which lack a designated calibration knob. The meter must read within 10 percent of the standard to be considered in control and acceptable.

If the calibration indicates the meter is out of calibration, a backup unit should be employed. Readings from conductivity meters lacking calibration adjustments are limited to checks at the beginning and end of the sampling day. All calibrations may be recorded in a bound field notebook along with conclusions as to the acceptability of readings.

Temperature is measured using a glass thermometer. Field thermometers must be periodically checked against a National Institute of Standards Technology (NIST) thermometer. Acceptance criteria are ±1°C. Any thermometers exceeding these limits should not be used to record temperature readings. The calibration frequencies noted above are the minimum requirements. Additional checks should be performed if the unit experiences harsh conditions or if readings become erratic.

5.3 pH Meter

Calibration is performed at the start of each sampling day using at least two standard calibration solutions which bracket the pH range expected in the samples. Standard calibration solutions are available as pH 4, pH 7, and pH 10. Calibration is recorded in either a bound field notebook or on field calibration forms. Calibration knobs are used to set the meter to read the value of the standard. The meter is then checked during the sampling period, using at least one standard, at a frequency which results in little or no calibration adjustment. If the reading varies by more than one-tenth of a unit between calibration checks, the frequency of the checks must be increased. Temperature and pH must be taken on an aliquot of the sample that is not used for laboratory analysis.

5.4 Dissolved Oxygen Meter

Calibration is performed at the start of each sampling day following instructions in the operation manual. The DO probe uses potassium chloride (KCl) solution contained within a membrane. This membrane and solution should be changed as part of daily calibration procedures. If a bubble is present behind the membrane, if the solution is not present, or if the solution has not been recently changed, accurate DO readings will not be obtained, and the membrane and solution will require replacement. For calibration, place the probe in its storage/calibration chamber within the instrument housing. Using the calibration mode, the instrument is self-calibrating. Calibrations should be recorded in a field notebook or on field calibration forms.

5.5 Equipment Deficiency/Operational Status Reporting

All calibrations will be recorded in a field notebook. These calibration records become part of the individual project files as documentation of the attainment of QA objectives.

6.0 PREVENTATIVE MAINTENANCE

6.1 Routine Maintenance

HRP personnel routinely maintain field equipment for optimal results. All maintenance procedures are documented in control logbooks designated for each piece of equipment. Any field activities involving routine maintenance will be recorded in field logbooks by the individual performing the adjustment of the equipment. Maintenance performed at an authorized repair service will be documented in the maintenance log, including service location, specific repair, and method of transport. Methods of routine maintenance depend on the instrument and manufacturer. The manufacturers' operations manuals will be the primary source of information for these procedures.

6.2 Documentation

Field Services Managers maintain all documentation concerning routine maintenance and non-routine repairs. All pertinent information regarding instrument status is recorded in personnel field log books along with calibration documentation.

6.3 Contingency

In the event that the primary field equipment is inoperable as determined by calibration difficulties, back-up field instruments will be obtained from other sources. These instruments will be calibrated prior to recording data. In no event shall instruments be used to record data unless the performance of the equipment has been documented.

7.0 REFERENCES FOR FIELD SCREENING METHODS

New York State Department of Environmental Conservation (NYSDEC). 2010. "DER-10, Technical Guidance for Site Investigation and Remediation", Division of Environmental Remediation. May 2010.

NYSDEC. Technical Procedural Guidance, Equipment Training, Calibration, and Maintenance, “Spill Guidance Manual” Section 2.2.

USEPA. 2017. “Standard Operating Procedure Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction potential [ORP], and turbidity)”, USEPA, Region 1, Quality Assurance Unit, Revision Number 3, Revised March 23, 2017.

APPENDIX B

TARGET COMPOUND LISTS and CONTRACT-REQUIRED QUANTITATION LIMITS

From: ***NYSDEC ANALYTICAL SERVICE PROTOCOL***
(NYSDEC. 2005. Analytical Service Protocol, July 2005.)

EXHIBIT C

TARGET COMPOUND LISTS (TCLs)

AND

CONTRACT REQUIRED QUANTITATION LIMITS (CRQLs)

PART I - SUPERFUND-CLP ORGANICS
and
PART II - SUPERFUND-CLP INORGANICS

INTRODUCTION

NOTE: *The values in these tables are minimum quantitation limits, not absolute detection limits. The amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to simply be detected above the background noise. Most of the quantitation limits in these tables are set at the concentrations in the sample equivalent to the concentration of the lowest calibration standard analyzed for each analyte.*

Specific quantitation limits are highly matrix dependent. It is expected that the laboratory make every effort possible to meet the quantitation limits listed herein but it is realized that these limits may not be achievable in all instances.

CRQL values listed on the following pages are based on the analysis of samples according to the specifications given in Exhibit D. Modifications to the sample amounts processed may deviate from those listed in Exhibit D, as long as the limits listed herein can still be achieved.

All CRQL values are rounded to two significant figures.

The term “Solids” is used to denote the following matrices: soil, sediment, sludge, tissue, ash, oil, or mixed phase samples.

CRQL values listed for solids (soil, sediments, etc., except for tissue) are all based on 100% solids content. The quantitation limits calculated by the Laboratory for soil/sediment, calculated on dry weight basis, as required by the Protocol, will be higher. Results for tissue samples should be reported on a wet weight basis, along with their Percent lipid (% Lipid) content.

Changes to the Organic Target Compound Lists (TCLs) (e.g. adding an additional analyte) or lower CRQLs may be requested under the flexibility clause in the contract.

PART I – SUPERFUND-CLP ORGANICS

Volatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Aqueous Samples

	Volatile Analyte	CAS Number	Trace Water By SIM (µg/L)	Trace Level Water (µg/L)	Low Level Water (µg/L)
1.	Dichlorodifluoromethane	75-71-8		0.50	5.0
2.	Chloromethane	74-87-3		0.50	5.0
3.	Vinyl Chloride	75-01-4		0.50	5.0
4.	Bromomethane	74-83-9		0.50	5.0
5.	Chloroethane	75-00-3		0.50	5.0
6.	Trichlorofluoromethane	75-69-4		0.50	5.0
7.	1,1-Dichloroethene	75-35-4		0.50	5.0
8.	1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		0.50	5.0
9.	Acetone	67-64-1		5.0	10.0
10.	Carbon Disulfide	75-15-0		0.50	5.0
11.	Methyl Acetate	79-20-9		0.50	5.0
12.	Methylene chloride	75-09-2		0.50	5.0
13.	trans-1,2-Dichloroethene	156-60-5		0.50	5.0
14.	Methyl tert-Butyl Ether	1634-04-4		0.50	5.0
15.	1,1-Dichloroethane	75-34-3		0.50	5.0
16.	cis-1,2-Dichloroethene	156-59-2		0.50	5.0
17.	2-Butanone	78-93-3		5.0	10.0
18.	Bromochloromethane	74-97-5		0.50	5.0
19.	Chloroform	67-66-3		0.50	5.0
20.	1,1,1-Trichloroethane	71-55-6		0.50	5.0
21.	Cyclohexane	110-82-7		0.50	5.0
22.	Carbon tetrachloride	56-23-5		0.50	5.0
23.	Benzene	71-43-2		0.50	5.0
24.	1,2-Dichloroethane	107-06-2		0.50	5.0
25.	1,4-Dioxane	123-91-1	1.0	25	125
26.	Trichloroethane	79-01-6		0.50	5.0

Volatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Aqueous Samples (Continued)

	Volatile Analyte	CAS Number	Trace Water By SIM (µg/L)	Trace Level Water (µg/L)	Low Level Water (µg/L)
27.	Methylcyclohexane	108-87-2		0.50	5.0
28.	1,2-Dichloropropane	78-87-5		0.50	5.0
29.	Bromodichloromethane	75-27-4		0.50	5.0
30.	cis-1,3-Dichloropropene	10061-01-5		0.50	5.0
31.	4-methyl-2-pentanone	108-10-1		5.0	10.0
32.	Toluene	108-88-3		0.50	5.0
33.	Trans-1,3-Dichloropropene	10061-02-6		0.50	5.0
34.	1,1,2-Trichloroethane	79-00-5		0.50	5.0
35.	Tetrachloroethene	127-18-4		0.50	5.0
36.	2-Hexanone	591-78-6		5.0	10.0
37.	Dibromochloromethane	124-48-1		0.50	5.0
38.	1,2-Dibromoethane	106-93-4	0.05	0.50	5.0
39.	Chlorobenzene	108-90-7		0.50	5.0
40.	Ethylbenzene	100-41-4		0.50	5.0
41.	Xylenes (Total)	1330-20-7		0.50	5.0
42.	Styrene	100-42-5		0.50	5.0
43.	Bromoform	75-25-2		0.50	5.0
44.	Isopropylbenzene	98-82-8		0.50	5.0
45.	1,1,2,2-Tetrachloroethane	79-34-5		0.50	5.0
46.	1,3-Dichlorobenzene	541-73-1		0.50	5.0
47.	1,4-Dichlorobenzene	106-46-7		0.50	5.0
48.	1,2-Dichlorobenzene	95-50-1		0.50	5.0
49.	1,2-Dibromo-3-chloropropane	96-12-8	0.05	0.50	5.0
50.	1,2,4-Trichlorobenzene	120-82-1		0.50	5.0
51.	1,2,3-Trichlorobenzene	87-61-6		0.50	5.0

Volatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Solid Samples

	Volatile Analyte	CAS Number	Low Level Soil (µg/Kg)	Med. Level Soil (µg/Kg)
1.	Dichlorodifluoromethane	75-71-8	5.0	500
2.	Chloromethane	74-87-3	5.0	500
3.	Vinyl Chloride	75-01-4	5.0	500
4.	Bromomethane	74-83-9	5.0	500
5.	Chloroethane	75-00-3	5.0	500
6.	Trichlorofluoromethane	75-69-4	5.0	500
7.	1,1-Dichloroethene	75-35-4	5.0	500
8.	1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	5.0	500
9.	Acetone	67-64-1	10.0	1000
10.	Carbon Disulfide	75-15-0	5.0	500
11.	Methyl Acetate	79-20-9	5.0	500
12.	Methylene chloride	75-09-2	5.0	500
13.	trans-1,2-Dichloroethene	156-60-5	5.0	500
14.	Methyl tert-Butyl Ether	1634-04-4	5.0	500
15.	1,1-Dichloroethane	75-34-3	5.0	500
16.	cis-1,2-Dichloroethene	156-59-2	5.0	500
17.	2-Butanone	78-93-3	10.0	1000
18.	Bromochloromethane	74-97-5	5.0	500
19.	Chloroform	67-66-3	5.0	500
20.	1,1,1-Trichloroethane	71-55-6	5.0	500
21.	Cyclohexane	110-82-7	5.0	500
22.	Carbon tetrachloride	56-23-5	5.0	500
23.	Benzene	71-43-2	5.0	500
24.	1,2-Dichloroethane	107-06-2	5.0	500
25.	1,4-Dioxane	123-91-1	125	12500
26.	Trichloroethane	79-01-6	5.0	500
27.	Methylcyclohexane	108-87-2	5.0	500
28.	1,2-Dichloropropane	78-87-5	5.0	500

Volatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Solid Samples (Continued)

	Volatile Analyte	CAS Number	Low Level Soil (µg/Kg)	Med. Level Soil (µg/Kg)
29.	Bromodichloromethane	75-27-4	5.0	500
30.	cis-1,3-Dichloropropene	10061-01-5	5.0	500
31.	4-methyl-2-pentanone	108-10-1	10.0	1000
32.	Toluene	108-88-3	5.0	500
33.	Trans-1,3-Dichloropropene	10061-02-6	5.0	500
34.	1,1,2-Trichloroethane	79-00-5	5.0	500
35.	Tetrachloroethene	127-18-4	5.0	500
36.	2-Hexanone	591-78-6	10.0	1000
37.	Dibromochloromethane	124-48-1	5.0	500
38.	1,2-Dibromoethane	106-93-4	5.0	500
39.	Chlorobenzene	108-90-7	5.0	500
40.	Ethylbenzene	100-41-4	5.0	500
41.	Xylenes (Total)	1330-20-7	5.0	500
42.	Styrene	100-42-5	5.0	500
43	Bromoform	75-25-2	5.0	500
44.	Isopropylbenzene	98-82-8	5.0	500
45.	1,1,2,2-Tetrachloroethane	79-34-5	5.0	500
46.	1,3-Dichlorobenzene	541-73-1	5.0	500
47.	1,4-Dichlorobenzene	106-46-7	5.0	500
48.	1,2-Dichlorobenzene	95-50-1	5.0	500
49.	1,2-Dibromo-3-chloropropane	96-12-8	5.0	500
50.	1,2,4-Trichlorobenzene	120-82-1	5.0	500
51.	1,2,3-Trichlorobenzene	87-61-6	5.0	500

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Aqueous Samples

	Semivolatile Analyte	CAS Number	Low Water By SIM[1] (µg/L)	Water (µg/L)
1.	Benzaldehyde	100-52-7		5.0
2.	Phenol	108-95-2	0.10	5.0
3.	Bis-(2-chlorothyl) ether	111-44-4		5.0
4.	2-Chlorophenol	95-57-8	0.10	5.0
5.	2-Methylphenol	95-48-7	0.10	5.0
6.	2,2’-Oxybis (1-chloropropane)[3]	108-60-1		5.0
7.	Acetophenone	98-86-2		5.0
8.	4-Methylphenol	106-44-5	0.10	5.0
9.	N-Nitroso-di-n-propylamine	621-64-7		5.0
10.	Hexachloroethane	67-72-1		5.0
11.	Nitrobenzene	98-95-3		5.0
12.	Isophorone	78-59-1		5.0
13.	2-Nitrophenol	88-75-5	0.10	5.0
14.	2,4-Dimethylphenol	105-67-9	0.10	5.0
15.	Bis (2-chloroethoxy) methane	111-91-1		5.0
16.	2,4-Dichlorophenol	120-83-2	0.10	5.0
17.	Naphthalene	91-20-3	0.10	5.0
18.	4-Chloroaniline	106-47-8		5.0
19.	Hexachlorobutadiene	87-68-3		5.0
20.	Caprolactam	105-60-2		5.0
21.	4-Chloro-3-methylphenol	59-50-7	0.10	5.0
22.	2-Methylnaphthalene	91-57-6		5.0
23.	Hexachlorocyclopentadiene	77-47-4		5.0
24.	2,4,6-Trichlorophenol	88-06-2	0.10	5.0
25.	2,4,5-Trichlorophenol[4]	95-95-4	0.20	10.0
26.	1,1’-Biphenyl	92-52-4		5.0
27.	2-Chloronaphthalene	91-58-7		5.0

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Aqueous Samples (Continued)

	Semivolatile Analyte	CAS Number	Low Water By SIM[1] (µg/L)	Water (µg/L)
28.	2-Nitroaniline[4]	88-74-4		10.0
29.	Dimethylphthalate	131-11-3		5.0
30.	2,6-Dinitrotoluene	606-20-2		5.0
31.	Acenaphthylene	208-96-8	0.10	5.0
32.	3-Nitroaniline[4]	99-09-2		10.0
33.	Acenaphthene	83-32-9	0.10	5.0
34.	2,4-Dinitrophenol[4]	51-28-5	0.20	10.0
35.	4-Nitrophenol[4]	100-02-7	0.20	10.0
36.	Dibenzofuran	132-64-9		5.0
37.	2,4-Dinitrotoluene	121-14-2		5.0
38.	Diethylphthalate	84-66-2		5.0
39.	Fluorene	86-73-7	0.10	5.0
40.	4-Chlorophenyl-phenyl ether	7005-72-3		5.0
41.	4-Nitroaniline[4]	100-01-6		10.0
42.	4,6-Dinitro-2-methylphenol[4]	534-52-1	0.20	10.0
43.	N-Nitrosodiphenylamine	86-30-6		5.0
44.	1,2,4,5-Tetrachlorobenzene	95-34-3		5.0
45.	4-Bromophenyl-phenylether	101-55-3		5.0
46.	Hexachlorobenzene	100-52-7		5.0
47.	Atrazine	108-95-2	0.10	5.0
48.	Pentachlorophenol	111-44-4	0.20	10.0
49.	Phenanthrene	95-57-8	0.10	5.0
50.	Anthracene	95-48-7	0.10	5.0
51.	Carbazole	108-60-1		5.0
52.	Di-n-butylphthalate	98-86-2		5.0

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Aqueous Samples (Continued)

	Semivolatile Analyte	CAS Number	Low Water By SIM[1] (µg/L)	Water (µg/L)
53.	Fluoroanthene	106-44-5	0.10	5.0
54.	Pyrene	621-64-7		5.0
55.	Butylbenzylphthalate	67-72-1		5.0
56.	3,3'-Dichlorobenzidine	98-95-3		5.0
57.	Benzo (a) anthracene	78-59-1		5.0
58.	Chrysene	88-75-5	0.10	5.0
59.	Bis (2-ethylhexyl) phthalate	105-67-9	0.10	5.0
60.	Di-n-octylphthalate	111-91-1		5.0
61.	Benzo (b) fluoranthene	120-83-2	0.10	5.0
62.	Benzo (k) fluoranthene	91-20-3	0.10	5.0
63.	Benzo (a) pyrene	106-47-8		5.0
64.	Indeno (1,2,3-cd) pyrene	87-68-3		5.0
65.	Benzo (a,h) anthracene	105-60-2		5.0
66.	Benzo (g,h,i) perylene	59-50-7	0.10	5.0

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Solid Samples

	Semivolatile Analyte	CAS Number	Low Level By SIM[1] (µg/Kg)	Low Level Solids[2] (µg/Kg)	Med. Level Solids[2] (µg/Kg)
1.	Benzaldehyde	100-52-7		170	50000
2.	Phenol	108-95-2	3.3	170	50000
3.	Bis-(2-chlorothyl) ether	111-44-4		170	50000
4.	2-Chlorophenol	95-57-8	3.3	170	50000
5.	2-Methylphenol	95-48-7	3.3	170	50000
6.	2,2’-Oxybis (1-chloropropane)[3]	108-60-1		170	50000
7.	Acetophenone	98-86-2		170	50000
8.	4-Methylphenol	106-44-5	3.3	170	50000
9.	N-Nitroso-di-n-propylamine	621-64-7		170	50000
10.	Hexachloroethane	67-72-1		170	50000
11.	Nitrobenzene	98-95-3		170	50000
12.	Isophorone	78-59-1		170	50000
13.	2-Nitrophenol	88-75-5	3.3	170	50000
14.	2,4-Dimethylphenol	105-67-9	3.3	170	50000
15.	Bis (2-chloroethoxy) methane	111-91-1		170	50000
16.	2,4-Dichlorophenol	120-83-2	3.3	170	50000
17.	Naphthalene	91-20-3	3.3	170	50000
18.	4-Chloroaniline	106-47-8		170	50000
19.	Hexachlorobutadiene	87-68-3		170	50000
20.	Caprolactam	105-60-2		170	50000
21.	4-Chloro-3-methylphenol	59-50-7	3.3	170	50000
22.	2-Methylnaphthalene	91-57-6		170	50000
23.	Hexachlorocyclopentadiene	77-47-4		170	50000
24.	2,4,6-Trichlorophenol	88-06-2	3.3	170	50000

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Solid Samples (Continued)

	Semivolatile Analyte	CAS Number	Low Level By SIM[1] (µg/Kg)	Low Level Solids[2] (µg/Kg)	Med. Level Solids[2] (µg/Kg)
25.	2,4,5-Trichlorophenol[4]	95-95-4	6.7	330	100000
26.	1,1'-Biphenyl	92-52-4		170	50000
27.	2-Chloronaphthalene	91-58-7		170	50000
28.	2-Nitroaniline[4]	88-74-4		330	100000
29.	Dimethylphthalate	131-11-3		170	50000
30.	2,6-Dinitrotoluene	606-20-2		170	50000
31.	Acenaphthylene	208-96-8	3.3	170	50000
32.	3-Nitroaniline[4]	99-09-2		330	100000
33.	Acenaphthene	83-32-9	3.3	170	50000
34.	2,4-Dinitrophenol[4]	51-28-5	6.7	330	100000
35.	4-Nitrophenol[4]	100-02-7	6.7	330	100000
36.	Dibenzofuran	132-64-9		170	50000
37.	2,4-Dinitrotoluene	121-14-2		170	50000
38.	Diethylphthalate	84-66-2		170	50000
39.	Fluorene	86-73-7	3.3	170	50000
40.	4-Chlorophenyl-phenyl ether	7005-72-3		170	50000
41.	4-Nitroaniline[4]	100-01-6		330	100000
42.	4,6-Dinitro-2-methylphenol[4]	534-52-1	6.7	330	100000
43.	N-Nitrosodiphenylamine	86-30-6		170	50000
44.	1,2,4,5-Tetrachlorobenzene	95-34-3		170	50000
45.	4-Bromophenyl-phenylether	101-55-3		170	50000
46.	Hexachlorobenzene	118-74-1		170	10000
47.	Atrazine	1912-24-9		170	50000
48.	Pentachlorophenol	87-86-5	6.7	330	100000

Semivolatiles Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) for Solid Samples (Continued)

	Semivolatile Analyte	CAS Number	Low Level By SIM[1] (µg/Kg)	Low Level Solids[2] (µg/Kg)	Med. Level Solids[2] (µg/Kg)
49.	Phenanthrene	85-01-8	3.3	170	50000
50.	Anthracene	120-12-7	3.3	170	50000
51.	Carbazole	86-74-8		170	50000
52.	Di-n-butylphthalate	84-74-2		170	50000
53.	Fluoroanthene	206-44-0	3.3	170	50000
54.	Pyrene	129-00-0	3.3	170	50000
55.	Butylbenzylphthalate	85-68-7		170	50000
56.	3,3'-Dichlorobenzidine	91-94-1		170	50000
57.	Benzo (a) anthracene	56-55-3	3.3	170	50000
58.	Chrysene	218-01-9	3.3	170	50000
59.	Bis (2-ethylhexyl) phthalate	117-81-7		170	50000
60.	Di-n-octylphthalate	117-84-0		170	50000
61.	Benzo (b) fluoranthene	205-99-2	3.3	170	50000
62.	Benzo (k) fluoranthene	207-08-9	3.3	170	50000
63.	Benzo (a) pyrene	50-32-8	3.3	170	50000
64.	Indeno (1,2,3-cd) pyrene	193-39-5	3.3	170	50000
65.	Benzo (a,h) anthracene	53-70-3	3.3	170	50000
66.	Benzo (g,h,i) perylene	191-24-2	3.3	170	50000

Semivolatile Notes

[1] CRQLs for optional analysis of water and soil samples using SIM (Selected Ion Monitoring) techniques for PAHs and phenols.

[2] Denotes soil, sediment, tissue, or mixed phase samples.

[3] Previously known as bis (2-Chloroisoproply) ether.

[4] Seven semivolatile compounds are calibrated using only a four point initial calibration, eliminating the lowest standard. Therefore, the CRQL values for these eight compounds are 2 times higher for all matrices and levels.

Pesticide Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) For Aqueous and Solid Samples

	Pesticide Analyte	CAS Number	Water (µg/L)	Solids[1] (µg/Kg)
1.	alpha-BHC	319-84-6	0.050	1.7
2.	beta-BHC	319-85-7	0.050	1.7
3.	delta-BHC	319-86-8	0.050	1.7
4.	gamma-BHC (Lindane)	58-89-9	0.050	1.7
5.	Heptachlor	76-44-8	0.050	1.7
6.	Aldrin	309-00-2	0.050	1.7
7.	Heptachlor epoxide[2]	1024-57-3	0.050	1.7
8.	Endosulfan I	959-98-8	0.050	1.7
9.	Dieldrin	60-57-1	0.10	3.3
10.	4,4'-DDE	72-55-9	0.10	3.3
11.	Endrin	72-20-8	0.10	3.3
12.	Endosulfan II	33213-65-9	0.10	3.3
13.	4,4'-DDD	72-54-8	0.10	3.3
14.	Endosulfan sulfate	1031-07-8	0.10	3.3
15.	4,4'-DDT	50-29-3	0.10	3.3
16.	Methoxychlor	72-43-5	0.10	3.3
17.	Endrin ketone	53494-70-5	0.10	3.3
18.	Endrin aldehyde	7421-93-4	0.10	3.3
19.	alpha-Chlordane	5103-71-9	0.050	1.7
20.	gamma-Chlordane	5103-74-2	0.050	1.7
21.	Toxaphene	8001-35-2	5.0	34

Pesticide Notes

[1] There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of pesticides.

[2] Only the exo-epoxy isomer (isomer B) of heptachlor epoxide is reported on the data reporting forms (Exhibit B).

PCB Aroclor Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) For Aqueous and Solid Samples

	Aroclor Analyte	CAS Number	Water (µg/L)	Solids[1] (µg/Kg)
1.	Arochlor-1016	12674-11-2	1.0	33
2.	Arochlor-1221	11104-28-2	1.0	33
3.	Arochlor-1232	11141-16-5	1.0	33
4.	Arochlor-1242	53469-21-9	1.0	33
5.	Arochlor-1248	12672-29-6	1.0	33
6.	Arochlor-1254	11097-69-1	1.0	33
7.	Arochlor-1260	11096-82-5	1.0	33
8.	Arochlor-1262	37324-23-5	1.0	33
9.	Arochlor-1268	11100-14-4	1.0	33

<u>Aroclor PCB Notes</u>

[1] There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of Aroclor PCBs.

PCB Congeners Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) For Aqueous and Solid Samples

	Congener Analyte	IUPAC Number	CAS Number	Water (pg/L)	Solids[1] (ng/Kg)
1.	2-MoCB	1	2051-60-7	20	2.0
2.	4-MoCB	3	2051-62-9	20	2.0
3.	2,2'-DiCB	4	13029-08-8	20	2.0
4.	4,4'-DiCB	15	2050-68-2	20	2.0
5.	2,2',6'-TrCB	19	38444-73-4	20	2.0
6.	3,4,4'-TrCB	37	38444-90-5	20	2.0
7.	2,2',6,6'-TeCB	54	15968-05-5	20	2.0
8.	3,3',4,4'-TeCB	77	32598-13-3	20	2.0
9.	3,4,4',5-TeCB	81	70362-50-4	20	2.0
10.	2,2',4,6,6'-PeCB	104	56558-16-8	20	2.0
11.	2,3,3',4,4'-PeCB	105	32598-14-4	20	2.0
12.	2,3,4,4',5-PeCB	114	74472-37-0	20	2.0
13.	2,3',4,4',5-PeCB	118	31508-00-6	20	2.0
14.	2',3,4,4',5-PeCB	123	65510-44-3	20	2.0
15.	3,3',4,4',5-PeCB	126	57465-28-8	20	2.0
16.	2,2',4,4',6,6'-HxCB	155	33979-03-2	20	2.0
17.	2,3,3',4,4',5-HxCB	156	38380-08-4	20	2.0
18.	2,3,3',4,4',5'-HxCB	157	69782-90-7	20	2.0
19.	2,3',4,4',5,5'-HxCB	167	52663-72-6	20	2.0
20.	3,3',4,4',5,5'-HxCB	169	32774-16-6	20	2.0
21.	2,2',3,4',5,6,6'-HpCB	188	74487-85-7	20	2.0
22.	2,2',3,4',5,6,6'-HpCB	189	39635-31-9	20	2.0
23.	2,2',3,3',5,5',6,6'-OcCB	202	2136-99-4	20	2.0
24.	2,3,3',4,4',5,5',6-OcCB	205	74472-53-0	20	2.0
25.	2,2',3,3',4,4',5,5',6-NoCB	206	40186-72-9	20	2.0

PCB Congeners Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) For Aqueous and Solid Samples (Continued)

	Congener Analyte	IUPAC Number	CAS Number	Water (pg/L)	Solids[1] (ng/Kg)
26.	2,2',3,3',4,5,5',6,6'-NoCB	208	52663-77-1	20	2.0
27.	DeCB	209	2051-24-3	20	2.0

Congener PCB Notes

[1] There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of congener PCBs.

PCDD/F Target Compound List (TCL) and Contract Required Quantitation Limits (CRQL) For Aqueous and Solid Samples

	PCDD/F Analyte	CAS Number	Water (pg/L)	Solids[1] (ng/Kg)
1.	2,3,7,8-TCDD	1746-01-6	10	1.0
2.	1,2,3,7,8-PeCDD	40321-76-4	50	5.0
3.	1,2,3,6,7,8-HxCDD	57653-85-7	50	5.0
4.	1,2,3,4,7,8-HxCDD	39227-28-6	50	5.0
5.	1,2,3,7,8,9-HxCDD	19408-74-3	50	5.0
6.	1,2,3,4,6,7,8-HpCDD	35822-46-9	50	5.0
7.	OCDD	3268-87-9	100	10
8.	2,3,7,8-TCDF	51207-31-9	10	1.0
9.	1,2,3,7,8-PeCDF	57117-41-6	50	5.0
10.	2,3,4,7,8-PeCDF	57117-31-4	50	5.0
11.	1,2,3,6,7,8-HxCDD	57117-44-9	50	5.0
12.	1,2,3,7,8,9-HxCDD	72918-21-9	50	5.0
13.	1,2,3,4,7,8-HxCDD	70648-26-9	50	5.0
14.	2,3,4,6,7,8-HxCDD	60851-34-5	50	5.0
15.	1,2,3,4,6,7,8-HpCDD	67562-39-4	50	5.0
16.	1,2,3,4,7,8,9-HpCDD	55673-89-7	50	5.0
17.	OCDF	39001-02-0	100	10

<u>PCDD/F Notes</u>

[1] There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of PCDDs and PCDFs.

Total PCDD/F Homologues

Data are reported for the total concentration of all detected chlorinated dibenzo-p-dioxins (CDD) or chlorinated dibenzofurans (CDF's) in the following homologues. However, because the number of non-2,3,7,8-substituted isomers that might be detected in a sample is unpredictable, it is not possible to assign Contract Required Quantitation Limits (CRQLs) values to the total homologue concentrations.

PCDD/F Homologue	CAS Number	No. of Possible Isomers	No. of 2,3,7,8-Substituted Isomers
Total TCDD	41903-57-5	22	1
Total PeCDD	36088-22-9	14	1
Total HxCDD	34465-46-8	10	3
Total HpCDD	37871-00-4	2	1
Total TCDF	55722-27-5	38	1
Total PeCDF	30402-15-4	28	2
Total HxCDD	55684-94-1	16	4
Total HpCDD	38998-75-3	4	2

There is only one isomer in both the OCDD on OCDF homologues, hence the total concentration is the same as the 2,3,7,8-substituted concentration.

Homologue	Definition
TCDD	Tetrachlorinated dibenzo-p-dioxin
PeCDD	Pentachlorinated dibenzo-p-dioxin
HxCDD	Hexachlorinated dibenzo-p-dioxin
HpCDD	Heptachlorinated dibenzo-p-dioxin
OCDD	Octachlorinated dibenzo-p-dioxin
TCDF	Tetrachlorinated dibenzofuran
PeCDF	Pentachlorinated dibenzofuran
HxCDD	Hexachlorinated dibenzofuran
HpCDD	Heptachlorinated dibenzofuran
OCDF	Octachlorinated dibenzofuran

PART II – SUPERFUND-CLP INORGANICS

Inorganic Target Compound List (TCL) and Contract Required Quantitation Limits (CRQLs) For Aqueous and Solid Samples

	Analyte	CAS Number	ICP-AES[1] CRQL for Water (µg/L)	ICP-AES[1] CRQL for Solids (mg/Kg)	ICP-MS[1] for Water (µg/L)
1.	Aluminum	7429-90-5	200	40	30
2.	Antimony	7440-36-0	60	12	2
3.	Arsenic	7440-38-2	15	3	1
4.	Barium	7440-39-3	200	40	10
5.	Beryllium	7440-41-7	5	1	1
6.	Cadmium	7440-43-9	5	1	1
7	Calcium	7440-70-2	5000	1000	--
8.	Chromium	7440-47-3	10	2	2
9.	Cobalt	7440-48-4	50	10	0.5
10.	Copper	7440-50-8	25	5	2
11.	Iron	7439-89-6	100	20	--
12.	Lead	7439-92-1	10	2	1
13.	Magnesium	7439-95-4	5000	1000	--
14.	Manganese	7439-96-5	15	3	0.5
15.	Mercury[2]	7439-97-6	0.2	0.1	--
16.	Nickel	7440-02-0	40	8	1
17.	Potassium	7440-09-7	5000	1000	--
18.	Selenium	7782-49-2	35	7	5
19.	Silver	7440-22-4	10	2	1
20.	Sodium	7440-23-5	5000	1000	--
21.	Thallium	7440-28-0	25	5	1
22.	Vanadium	7440-62-2	50	10	1
23.	Zinc	7440-66-6	60	12	1
24.	Cyanide[2]	57-12-5	10	1	--

Inorganic Notes

[1] Any analytical method specified in Exhibit D, may be utilized as long as the documented instrument or method detection limits (IDLs or MDLs) are less than one half the Contract Required Quantitation Level (CRQL) requirements. Higher quantitation levels may only be used in the following circumstance:

If the sample concentration exceeds five times the quantitation limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Quantitation Limit. This is illustrated in the example below:

For lead:
Method in use = ICP
Instrument Detection Limit (IDL) = 40
Sample concentration = 220
Contract Required Quantitation Level (CRQL) = 3

The value of 220 may be reported even though instrument detection limit is greater than Contract Required Quantitation Limit. The instrument or method detection limit must be documented as described in Exhibit E.

[2] Mercury is analyzed by cold vapor atomic absorption. Cyanide is analyzed by colorimetry/spectrophotometry.

APPENDIX D

Laboratory PFAS Standard Operating Procedures (SOPs)

Title: Per- and Poly-fluorinated Substances (PFAS) in Water, Soils, Sediments and Tissue

[Method 537 (Modified), PFAS by LCMSMS]

Approvals (Signature):

Kristine Dusablon

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Kristine Dusablon
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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 is amenable with water, soil, sediment and tissue sample matrices.
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 (Perfluoro-n-butyric 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	PFHxDA	67905-19-5
Perfluoro-n-octadecanoic acid	PFODA	16517-11-6
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
Perfluorododecanesulfonic 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-perfluorohexanesulfonic acid *(4:2)*	4:2 FTS	757124-72-4
1H,1H,2H,2H-perfluorooctanesulfonic acid *(6:2)*	6:2 FTS	27619-97-2

1H,1H,2H,2H-perfluorodecanesulfonic acid *(8:2)*	8:2 FTS	39108-34-4
1H,1H,2H,2H-perfluorododecane sulfonic acid (10:2)	10:2 FTS	120226-60-0
Fluorinated Replacement Chemicals		
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	DONA	919005-14-4
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	F53B Major (9Cl-PF3ONS)	756426-58-1
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	F53B Minor (11Cl-PF3OUdS)	763051-58-1

Abbreviations in parenthesis are the abbreviations listed in Method 537, where they differ from the abbreviation used by the laboratory's LIMS.
***Indicates the analyte is not certified in any state or program.**
Analytes with secondary certification in NJDEP can be found in Appendix D.

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 µg/Kg–2.0 µg/Kg	0.2 µg/Kg-40 µgKg
Tissue	1 g	1.0 µg/Kg–10 µg/Kg	1.0 µg/Kg–200 µg/Kg

On occasion clients may request modifications to this SOP. These modifications are handled following the procedures outlined in the Quality Assurance Manual.

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 [redacted] solution.

Soil/sediment/tissue samples are extracted with a [redacted] solution using a TCLP tumbler operating at [redacted] The mixture is centrifuged to reduce the amount of solid transferred when decanting the solvent. The solvent extract is exchanged to water using nitrogen blowdown, then the aqueous extract is extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide/methanol solution.

The final [redacted] 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 [redacted] and methanol.

An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDAs) consist of carbon-13 labeled analogs, oxygen-18 labeled analogs, or deuterated analogs of the compound 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 quantified by the IDA method using a closely related labeled analog.

Quantitation by the internal standard method is employed for the IDA analytes/recoveries. Peak 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

Refer to the Laboratory's Quality Assurance Manual (QAM) for the Glossary of Terms, Definitions and Acronyms except as follows.

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 PFAS. 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.

Per the Certificate of Analysis for labeled perfluorohexadecanoic acid (13C2-PFHxDA) produced by Wellington Laboratories, the stock standard contains roughly 0.3% of native perfluorohexadecanoic acid. The laboratory utilizes a weighted linear regression that is not forced through the origin for the calibration of native perfluorohexadecanoic acid to account for this contribution from its labeled IDA.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001), Radiation Safety Manual 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.

Laboratory procedures such as the use of pipets and transferring of extracts 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.

Eye protection that satisfies ANSI Z87.1 (as per the Eurofins TestAmerica Corporate Safety Manual), a 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.

Perfluorocarboxylic acids are acids and are not compatible with strong bases.

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.

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 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, [redacted] 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, [redacted], or equivalent.
- SPE Stopcocks, Polyethylene and Polypropylene, [redacted], or equivalent.
- Stainless steel solvent guide needles, [redacted], or equivalent.
- Heavy-Wall filter flask, Fisherbrand 4000mL, [redacted], or equivalent.
- TCLP tumbler, [redacted] for extraction of soil, sediment and tissue samples.
- Glass-Col ZipVap 24-port extract concentrator.

- Polypropylene Syringe, 10 mL with luer-lok or luer slip tips, [redacted] 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.
- Waters Oasis [redacted] or equivalent, for the extraction of PFAS from aqueous samples.
- Waters Oasis [redacted] or equivalent, for the cleanup of soils.
- 250mL Poly bottles containing 1.25g of Trizma Pre-Set Crystals, used for batch QC for samples received with Trizma preservation.
- 50mL graduated polypropylene centrifuge tubes. [redacted] or equivalent.
- 500ml Polyethylene wash bottle
- 4, 6, and 12ml Class A Volumetric Pipette
- Graphitized carbon (Envi-Carb™ or equivalent)
- Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc). These should be disposable wherever possible, or marked and segregated for high-level versus low-level use.

6.2 Analytical System

Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS)-as described below. 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.

- SCIEX LC/MS/MS

  This system consists of a [redacted] HPLC interfaced with a [redacted]. The instrument control and data acquisition software is [redacted] [redacted]r equivalvent.

  [redacted] HPLC equipped with [redacted] and [redacted] or equivalent. [redacted] Column Oven.

  [redacted], or equivalent.

  PFAS Isolator column. [redacted]. These are plumbed between the pump's mixing valve and the autosampler to minimized the HPLC-based PFAS background from injection-based PFAS.

7.0 Reagents and Standards

7.1 Reagents

All reagents must follow traceability guidelines found in SOP BR-QA-002.

- Ammonium acetate Stock Solution [redacted]
- [redacted] ammonium acetate eluent.. [redacted]

- Ammonium hydroxide, concentrated, JT Baker or equivalent.
- Ammonium hydroxide (NH_4OH) ([redacted] of Methanol. Volume prepared may be adjusted based on usage/need.
- Potassium hydroxide pellets, 87% purity, JT Baker P250-1 or equivalent.
- Potassium hydroxide (KOH), [redacted]
- Reagent Water, house reverse-osmosis reagent water (“PFAS-Free” via in-house testing).
- Hexane, Ultra-Resi Analyzed, JT Baker or equivalent.
- Methanol, HPLC JT Baker or equivalent.
- Sodium hydroxide, pellets, JT Baker or equivalent.
- Sodium hydroxide (NaOH), [redacted]
- Acetonitrile, Optima Grade, Fisherbrand or equivalent.

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°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.

Per the Certificate of Analysis for labeled perfluorohexadecanoic acid (13C2-PFHxDA) produced by Wellington Laboratories, the stock standard contains ~0.3% of native PFHxDA. This equates to roughly 0.30 ng/L or 0.015 ug/Kg of PFHxDA expected in all samples and blanks.

As of this writing, only PFOS, PFOA, PFHxS, MeFOSAA and EtFOSAA 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.

PFBS, PFHxS, PFHpS, PFOS, PFDS, 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.

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.

While PFAS standards commercially purchased are supplied in glass ampoules, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene or HDPE containers.

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. For those compounds not available in this mixture or are not available from another vendor, 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 ISTD are added at a fixed concentration (2.5 ng/mL in extract).

7.3 Extraction Spiking Solutions

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 IDA compound at a concentration of 1000 ng/mL in methanol.

Internal Standard Solution, $^{13}C_2$-PFOA, 2500 ng/mL

The internal standard solution is prepared by diluting the stock 50 µg/mL $^{13}C_2$-PFOA 20-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.

Sample container, preservation techniques and holding times may vary and are dependent on sample matrix, method of choice, regulatory compliance, and/or specific contract or client requests. Listed below are the holding times and the references that include preservation requirements.

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]	Reference
Water	250 mL HDPE Bottle	250 mL	0-6°C, Trizma (5g/L) (if from a known	14 days from collection	Method 537

			chlorinated source)		
Soil/Sediment	4/8 oz HDPE wide-mouth container	100 g	0-6°C	14 days from collection	SW-846 Organic Methods
Extract	700 µL Polypropylene (PP) Vial with HDPE Screw cap	NA	0-6°C	40 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

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 MS/MSD or duplicate.

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 and 5 (in order) throughout sequence	See Table 3
Continuing Calibration Verification Low (CCVL)	Immediately prior to 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-016. 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 [redacted] or equivalent). Gravity or vacuum can be used to pass the sample through the filter. Prepare a filtration blank and LCS 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 prior to filtration (if enough sample is available, perform an MS on each sample); 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 both spiked and extracted are 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 0.50 mL of PFAS LOQV 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 [redacted] of the PFAS-IDA solution (Section 7.2) into each sample and QC sample, for a fixed concentration of 2.5 ng/mL in extract.

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).

10.1.1 Solid Phase Extraction (SPE) of Aqueous Samples

Condition the SPE cartridges [redacted]) by passing the following without drying the column.

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 [redacted].

Wash with 5.0 mL of [redacted]. Close valve when ~ 1 mL remains on top to keep column wet. After this step, the columns should not go dry until the completion of loading and rinsing samples.

Appropriately label the SPE cartridges.

Add a poly siphon line to an adapter which has been firmly inserted into the SPE cartridge and 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 [redacted].

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.

10.1.2 SPE Column Wash of Aqueous Samples with Hexane

Add [redacted] to each SPE column and let the column become fully saturated with solvent. Close the stopcock and allow the column to soak for five minutes, then elute to waste.

Load a second [redacted] 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.

10.1.3 SPE Elution of Aqueous Samples

Note: the use of glass should be avoided where able. However, disposable glass pipettes have a much narrower opening, which is necessary to reduce spillage during the following transfer steps.

Place labeled 15 mL polypropylene test tubes containing [redacted] of Reagent Water as receiving tubes in the SPE manifold.

Rinse the dried sample bottles with [redacted] 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 the sample bottle rinse to cartridge elution process with a [redacted] (without the soaking period) The total collection should be approximately 10 mL. Adjust to 10 mL with methanol.

10.1.4 Sample Cleanup with Graphitized Carbon (Optional)

NOTE: If this step is to be performed, do not add the [redacted] to the receiving tubes prior to extract collection. Add [redacted] of graphitized carbon to each sample extract and QC extracts to aid in the removal of organic interferences. Shake vigorously and then let sit for 10 minutes. Centrifuge each sample for 2 minutes at 1000 rpm. Decant the solvent layer into a new 15mL centrifuge tube containing 2 mL of Reagent Water and swirl to mix. Adjust the volume to 10 mL with methanol.

10.1.5 Internal Standard Addition

Add [redacted] internal standard to each extract and vortex to mix well.

Transfer a portion of the extract to a labeled 300µL polypropylene autosampler vial (6 drops or approximately 60µL). Archive the rest of the extract in the event the sample needs re-injection and/or 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 Soil Sample Preparation

Visually inspect soil samples for homogeneity. Weigh a representative 5 g aliquot of soil, sediment or 1 g of tissue sample into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested and enough sample mass is available. Weigh 5 g aliquots of Ottawa sand or 0.1 g of oil for the MB and LCS samples.

Spike the LCS and MS/MSD (if requested) with 25 µL LCS/Matrix Spike Solution. This will result in a sample concentration of 2.0 ng/g (1.0 ng/mL ext).

Add [redacted] of IDA PFC Spiking Solution into each sample and QC sample, for a fixed concentration of 2.5 ng/mL in the final sample vial.

Cap the sample tubes and allow the spikes to settle into the sample matrix. Gently shake the bottles to mix the spike into the matrix.

Add [redacted]l to each sample. Cap each sample and shake lightly to confirm container is sealed.

Place all samples in the prep batch into the TCLP tumbler and tumble for 3 hours.

After removing the samples from the tumbler, gently shake each container to confirm the solid material has settled to the bottom of the centrifuge tube, then place in a sonic bath for 12 hours.

Centrifuge each sample at 3500 rpm for 15 minutes.

Transfer the supernate (solvent) to a second, labeled 50 mL centrifuge tube containing 2 mL of Reagent Water.

Slowly add [redacted]l to original 50 mL extraction tube. Pour the 2 mL of solvent rinse into the second labeled tube to complete the quantitative transfer.

Place extracts in the ZipVap set to 60 C for ~3 hours with nitrogen flow just strong enough to gently ripple the surface of the extracts. The concentration step is complete when the final volume either gets below 2 mL or maintains at the same level after consecutive checks a 5 minute intervals (this may be due to sample-based moisture contributing to the amount of water in the extract). Remove the sample from the ZipVap when the concentration has completed and allow the extracts to cool.

Adjust the volume of each sample's extract to 15 mL with Reagent Water and add 75 uL of Glacial Acetic Acid to neutralize the solution to pH 6-8. If the extracts contain suspended solids, centrifuge them at 3500 rpm for 15 minutes.

10.2.1 Solid Extract Cleanup by SPE

Condition the SPE cartridges [redacted] by passing the following without drying the column.

Wash with [redacted] with [redacted]. Wash with a second [redacted] followed by a second [redacted]. Close valve when ~ 0.5 mL remains on top to keep column wet. After this step, the columns should not go dry until the completion of loading and rinsing samples.

Appropriately label the SPE cartridges.

Pour each aqueous sample extract into its corresponding SPE cartridge until it is filled. Turn on the vacuum and open the stopcock to load the sample onto the cartridge. Add the remaining extract to the cartridge before it goes dry and stop the flow just before all of the sample has been drawn into the media. [redacted] to the 50 mL centrifuge tube to rinse the tube and complete the quantitative transfer. Pour this rinse into the SPE cartridge and open the stopcock to load the rest of the rinsate onto the cartridge. The added water volume ensures there are no small sample droplets remaining that may be clinging to the wall of the SPE cartridge. Set the centrifuge tubes aside and allow them to completely dry.

After the sample and water rinse has passed through the cartridge, allow the cartridge to completely dry with vacuum (this could take up to 30 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.

10.2.2 SPE Column Wash of Solid Extracts with Hexane

Add [redacted] of hexane to each SPE column and let the column become fully saturated with solvent. Close the stopcock and allow the column to soak for five minutes, then elute to waste.

Load a second [redacted] 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.

10.2.3 SPE Elution of Solid Extracts

Place labeled 15 mL polypropylene test tubes containing [redacted] as receiving tubes in the SPE manifold.

Rinse the dried sample tubes with [redacted] and transfer to the corresponding SPE cartridge. Allow the solution to soak the cartridge for 5 minutes and then elute into the 15 mL collection tube.

Repeat sample bottle rinse to cartridge elution process with [redacted] (without the soaking period) The total collection should be approximately 10 mL. Adjust to 10 mL with methanol.

10.2.4 Sample Cleanup with Graphitized Carbon (Optional)

NOTE: If this step is to be performed, do not add the [redacted] to the receiving tubes prior to extract collection. Add [redacted] of graphitized carbon to each sample extract and QC extracts to aid in the removal of organic interferences. Shake vigorously and then let sit for 10 minutes. Centrifuge each sample for 2 minutes at 1000 rpm. Decant the solvent layer into a new 15mL centrifuge tube containing 2 mL of Reagent Water and swirl to mix. Adjust the volume to 10 mL with methanol.

10.2.5 Internal Standard Addition

Add [redacted] internal standard to each extract and vortex to mix well.

Transfer a portion of the extract to a labeled 300µL polypropylene autosampler vial (6 drops or approximately 60µL). Archive the rest of the extract in the event the sample needs re-injection and/or 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.

10.3 Instrument Operating Conditions

Suggested operating conditions are listed below for the [redacted] LCMS system:

Recommended Instrument Operating Conditions					
HPLC Conditions (Shimadzu HPLC)					
Column (Column temp = 45°C)	Phenomenex Gemini C18 3um, 3.0mm x 100mm				
Mobile Phase Composition	A=20mM Ammonium Acetate (90/10 water/methanol) B=Methanol				
Gradient Program	**Time**	**%A**	**%B**	**Curve**	**Flow Rate mL/min.**
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	[redacted]	[redacted]	[redacted]	6	0.60
	Maximum pressure limit = 5,000 psi				
Injection Size	[redacted]				
Run Time	[redacted]				
Mass Spectrometer Interface Settings [redacted]					
MS Interface Mode	[redacted]				
Ionspray (volts)	-[redacted]				
Declustering Potential-DP (volts)	[redacted]				
Entrance Potential-EP (volts)	[redacted]				

Source Temp (TEM)	[redacted]
Curtain Gas (CUR)	[redacted]
Collision Gas (CAD)	[redacted]
Ion Source Gas 1 (GS1)	[redacted]
Ion Source Gas 2 (GS2)	[redacted]
Collision Energy-CE (volts)	[redacted]
Collision Cell Exit Potential-CXP (volts)	[redacted]

Recommended Instrument Operating Conditions

Mass Spectrometer Scan Settings [redacted]

Compound	Comments	Reaction (MRM)	Dwell (sec)	DP(v)	EP(v)	CE(v)	CXP(v)
PFBA	Native analyte	212.9 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C4 PFBA	IDA	217.0 > 172.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFPeA	Native analyte	262.9 > 219.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C5 PFPeA	IDA	267.9 > 223.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFBS	Native analyte	298.9 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFBS_2	Native analyte	298.9 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C3 PFBS	IDA	301.9 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxA	Native analyte	313.0 > 269.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxA_2	Native analyte	313.0 > 119.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFHxA	IDA	315.0 > 270.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
4:2FTS	Native analyte	327.0 > 307.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
M2-4:2FTS	IDA	329.0 > 81.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFPeS	Native analyte	349.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFPeS_2	Native analyte	349 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
HFPO-DA	Native analyte	329.1 > 285	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C3 HFPO-DA	IDA	332.1 > 287	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpA	Native analyte	363.0 > 319.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpA_2	Native analyte	363.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C4 PFHpA	IDA	367.0 > 322.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxS	Native analyte	399.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHxS_2	Native analyte	399.0 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
18O2 PFHxS	IDA	403.0 > 84.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
DONA	Native analyte	377 > 251	0.011	[redacted]	[redacted]	[redacted]	[redacted]
DONA_2	Native analyte	377 > 85	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFOA	Native analyte	413.0 > 369.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFOA_2	Native analyte	413.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C2 PFOA	Internal Std	415.0 > 370.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
13C4 PFOA	IDA	417.0 > 372.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
6:2FTS	Native analyte	427.0 > 407.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
M2-6:2FTS	IDA	429.0 > 81.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpS	Native analyte	449.0 > 80.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFHpS_2	Native analyte	449.0 > 99.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFNA	Native analyte	463.0 > 419.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]
PFNA_2	Native analyte	463.0 > 169.0	0.011	[redacted]	[redacted]	[redacted]	[redacted]

13C5 PFNA	IDA	468.0 > 423.0	0.011	[redacted]
PFOS	Native analyte	499.0 > 80.0	0.011	[redacted]
PFOS_2	Native analyte	499.0 > 99.0	0.011	[redacted]
9Cl-PF3ONS	Native analyte	531 > 351	0.011	[redacted]
13C4 PFOS	IDA	503.0 > 80.0	0.011	[redacted]
PFDA	Native analyte	513.0 > 469.0	0.011	[redacted]
PFDA_2	Native analyte	513.0 > 169.0	0.011	[redacted]
13C2 PFDA	IDA	515.0 > 470.0	0.011	[redacted]
8:2FTS	Native analyte	527.0 > 507.0	0.011	[redacted]
M2-8:2FTS	IDA	529.0 > 81.0	0.011	[redacted]
PFNS	Native analyte	549.0 > 80.0	0.011	[redacted]
PFNS_2	Native analyte	549.0 > 99.0	0.011	[redacted]
MeFOSAA	Native analyte	570 > 419.0	0.011	[redacted]
d3-MeFOSAA	IDA	573.0 > 419.0	0.011	[redacted]
11Cl-PF3OUdS	Native analyte	631 > 451	0.011	[redacted]
FOSA	Native analyte	498.0 > 78.0	0.011	[redacted]
13C8 FOSA	IDA	506.0 > 78.0	0.011	[redacted]
PFUdA	Native analyte	563.0 > 519.0	0.011	[redacted]
PFUdA_2	Native analyte	563.0 > 169.0	0.011	[redacted]
13C2 PFUdA	IDA	565.0 > 520.0	0.011	[redacted]
EtFOSAA	Native analyte	584.0 > 419.0	0.011	[redacted]
d5-EtFOSAA	IDA	589.0 > 419.0	0.011	[redacted]
PFDS	Native analyte	599.0 > 80.0	0.011	[redacted]
PFDS_2	Native analyte	599.0 > 99.0	0.011	[redacted]
PFDoA	Native analyte	613.0 > 569.0	0.011	[redacted]
PFDoA_2	Native analyte	613.0 > 169.0	0.011	[redacted]
13C2 PFDoA	IDA	615.0 > 570.0	0.011	[redacted]
10:2FTS	Native analyte	627 > 607	0.011	[redacted]
PFDoS	Native analyte	699 > 80	0.011	[redacted]
PFDoS_2	Native analyte	699 > 99	0.011	[redacted]
PFTrDA	Native analyte	663.0 > 619.0	0.011	[redacted]
PFTrDA_2	Native analyte	663.0 > 169.0	0.011	[redacted]
PFTeDA	Native analyte	713.0 > 669.0	0.011	[redacted]
PFTeDA_2	Native analyte	713.0 > 169.0	0.011	[redacted]
13C2 PFTeDA	IDA	715.0 > 670.0	0.011	[redacted]
PFHxDA	Native analyte	813 > 769	0.011	[redacted]
PFHxDA_2	Native analyte	813 > 169	0.011	[redacted]
13C2 PFHxDA	IDA	815 > 770	0.011	[redacted]
PFODA	Native analyte	913 > 869	0.011	[redacted]
PFODA_2	Native analyte	913 > 169	0.011	[redacted]

Recommended Instrument Operating Conditions

Retention Times & Quantitation ([redacted])

Native Compounds	Typical Native RT (minutes)	IS analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	[redacted]	13C4 PFBA	[redacted]	Isotope Dilution
PFPeA	[redacted]	13C5 PFPeA	[redacted]	Isotope Dilution
PFBS	[redacted]	13C3 PFBS	[redacted]	Isotope Dilution
4:2FTS	[redacted]	M2-4:2FTS	[redacted]	Internal Standard
PFHxA	[redacted]	13C2 PFHxA	[redacted]	Isotope Dilution
PFPeS	[redacted]	13C3 PFBS	[redacted]	Internal Standard
HFPO-DA	[redacted]	13C3 HFPO-DA	[redacted]	Isotope Dilution
PFHpA	[redacted]	13C4 PFHpA	[redacted]	Isotope Dilution
PFHxS	[redacted]	18O2 PFHxS	[redacted]	Isotope Dilution
DONA	[redacted]	13C4 PFOS	[redacted]	Internal Standard
6:2FTS	[redacted]	M2-6:2FTS	[redacted]	Isotope Dilution
PFOA	[redacted]	13C4 PFOA	[redacted]	Isotope Dilution
PFHpS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
PFNA	[redacted]	13C5 PFNA	[redacted]	Isotope Dilution
PFOS	[redacted]	13C4 PFOS	[redacted]	Isotope Dilution
9Cl-PF3ONS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
8:2FTS	[redacted]	M2-8:2FTS	[redacted]	Isotope Dilution
PFDA	[redacted]	13C2 PFDA	[redacted]	Isotope Dilution
PFNS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
MeFOSAA	[redacted]	d3-MeFOSAA	[redacted]	Isotope Dilution
11Cl-PF3OUdS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
EtFOSAA	[redacted]	d5-EtFOSAA	[redacted]	Isotope Dilution
PFDS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
PFUdA	[redacted]	13C2 PFUdA	[redacted]	Isotope Dilution
FOSA	[redacted]	13C8 FOSA	[redacted]	Isotope Dilution
PFDoA	[redacted]	13C2 PFDoA	[redacted]	Isotope Dilution
10:2FTS	[redacted]	M2-8:2FTS	[redacted]	Internal Standard
PFDoS	[redacted]	13C4 PFOS	[redacted]	Internal Standard
PFTrDA	[redacted]	13C2 PFTeDA	[redacted]	Internal Standard
PFTeDA	[redacted]	13C2 PFTeDA	[redacted]	Isotope Dilution
PFHxDA	[redacted]	13C2 PFHxDA	[redacted]	Isotope Dilution
PFODA	[redacted]	13C2 PFHxDA	[redacted]	Internal Standard

Note: clients must be notified when the quantitation of an analyte is performed using an Internal standard. Changes to these IDA/ISTD associations may be necessary when sources of IDAs are updated: this may include additions as new IDAs become available, or subtractions if IDAs are unavailable.

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 < 20% 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 < 25% 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.

10.6 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 Sciex’s Analyst 1.6.

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 < 20%, all analytes calibrated using ISTD must have RSD values < 25%. 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) $\geq$ 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.

10.7 Initial Calibration Blank (ICB)

Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of [redacted] 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.

10.8 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 recovery 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.

10.9 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.

10.10 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.

10.11 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 instrument 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. Verify that multiplier is functioning.

10.12 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

Injection Number	Lab Description
4	Primer 4
5	Blank
6	Calibration Level 1
7	Calibration Level 2
8	Calibration Level 3
9	Calibration Level 4 (ICIS)
10	Calibration Level 5
11	Calibration Level 6
12	ICB
13	ICV
14	T-PFOA
15	MB
16	LCS
17-26	(up to) 10 Field samples
27	CCV L4
28-37	(up to) 10 Field samples
38	MS
39	MSD
40	CCV L5
41	MB
42	LCS
43-52	(up to) 10 Field samples
53	CCV L4
54-63	(up to) 10 Field samples
65	MS
66	MSD
67	CCV L5

An example analytical sequence without ICAL:

Injection Number	Lab Description
1	Primer 1
2	Primer 2
3	Primer 3
4	Primer 4
5	CCB
6	CCVL (LOQV)
7	CCVIS (L4)
8	MB
9	LCS
10-19	(up to) 10 Field samples
20	CCV L5
21-30	(up to) 10 Field samples
31	MS
32	MSD
33	CCV L4
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 L4

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 Corrective Action

When an out-of-control situation occurs that is not delineated in this corrective action table or the corrective actions listed do not adequately address the circumstances, a Corrective Action Report (CAR) (NCM), etc., must be developed (see SOP BR-QA-016) and the analyst must use his/her best analytical judgment and available resources to determine the corrective action to be taken. The out-of-control situation may be caused by more than one variable. The analyst should seek the assistance of his/her immediate supervisor, QA manager or other experienced staff if they are uncertain of the cause of the out-of-control situation. The analysis must not be resumed until the source of the problem and an in-control status is re-established. All samples associated with the out-of-control situation must be reanalyzed after in-control status has been re-established or if authorization is received from the supervisor or QA Manager for release with data qualification.

12.0 Calculations / Data Reduction

12.1 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 CCVIS standards. *Note: The IS RT and native RT may be offset by 0.02 to 0.04 minutes.*

12.2 Quantitative Identification

The ICAL established in Section 10.10 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.

12.3 Calculations

See Appendix C.

12.4 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.

12.5 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.

12.6 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.

12.7 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.

13.0 Method Performance

13.1 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. MDLs reflect a calculated (statistical) value determined under ideal laboratory conditions in a clean matrix, and may not be achievable in all environmental matrices. An initial method detection limit study is performed in accordance with SOP BR-QA-005. The laboratory maintains MDL studies for analyses performed; these are verified at least annually unless method or program requirements require a greater frequency.

13.2 Demonstration of Capabilities

All personnel are required to perform an initial demonstration of proficiency (IDOC) on the instrument they will be using for analysis prior to testing samples. On-going proficiency must be demonstrated annually. IDOCs and on-going proficiency demonstrations are conducted as follows.

13.2.1 Four aliquots of the QC check sample are analyzed using the same procedures used to analyze samples, including sample preparation. The concentration of the QC check sample can be equivalent to a mid- level calibration.

13.2.2 Calculate the average recovery and standard deviation of the recovery for each analyte of interest.

13.2.3 If any analyte does not meet the acceptance criteria, the test must be repeated. Only those analytes that did not meet criteria in the first test need to be evaluated. TNI 2016 requires consecutive passing results. Repeated failure for any analyte indicates the need for the laboratory to evaluate the analytical procedure and take corrective action.

13.2.4 Until the IDOC is approved by the QA Manager (or designee); the trainer and trainee must be identified in the batch record.

13.3 Training Requirements

The Group Leader is responsible for ensuring that this procedure is performed by an associate who has been properly trained in its use and has the required experience. A new analyst must be working under documented supervision prior to approval of the IDOC. Documentation that a new analyst is performing under supervision must be entered into the batch record (View Batch Information) until that analyst's IDOC has been approved by the QA Manager (or designee). See requirements for demonstration of analyst proficiency in SOP BR-QA-011.

14.0 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."

15.0 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.

16.0 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)
- Corporate TestAmerica SOP CA-Q-S-002 *Manual Integrations*.

17.0 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.

18.0 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

19.0 Revision History (all revision history must be retained in this SOP)

Revision 6.0

- Updated cover page dates, copyright information, and signatories
- Throughout: Added support for soil, sediment and tissue matrices.
- Throughout: Removed reference to analysis using Waters instrumentation.
- Throughout: Removed reference to final extract concentration for aqueous samples.
- Section 1.1: Update Fluorotelomer sulfonates (FTS) to report acid forms
- Section 11.0: Added corrective action requirement as it is a corporate requirement to include.

Revision 5.0

- Updated cover page dates, copyright information, and signatories
- Throughout: removed references to drinking water. Will add back if adopted.
- Throughout: removed solid extraction/analysis verbiage missed in previous revision.
- Throughout: revised formatting to be consistent
- Throughout: added PFHxDA, PFODA, PFDoS, 10:2FTS, HFPO_DA, DONA, F53BMajor, and F53B Minor as additional analytes and IDAs
- Section 4.0: added interference information about $^{13}C_2$-PFHxDA
- Section 6.1: updated to include additional laboratory apparatus information
- Section 6.2: updated to include additional instrument and more detail for existing instrument
- Section 7.1: added more detail to reagent information and the addition of Ammonium acetate and Ammonium hydroxide
- Section 7.2: added PFHpS and PFDS as other PFAS not available in the acid form. Added the IDA and ISTD are added at a fixed concentration and removed the low level reference
- Section 9.1 added a NCM must be added for MS/MSD
- Section 10.1: removed the low level spike reference and added the PFAS-IDA solution is added to each sample and QC sample in concentrated extract and non-concentrated extracts
- Section 10.2: In the previous version of this SOP, the “Note” was removed and replaced with “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.”
- Section 10.2: changed wording to clarify addition of poly siphon line into the SPE cartridge
- Section 10.3: removed to keep test tube as keep and added “Note: If the extracts will note be concentrated, use [redacted] for the second bottle rinse so the final volume is approximately 8mL.”
- Section 10.5: added sample cleanup with graphitized carbon section
- Section 10.6: added wording to have [redacted] of reagent water to the 10mL extract at this time
- Section 10.7: updated wording
- Section 10.8: added operating system for new instrument and added more detail for existing instrument
- Section 10.17: updated sample analysis to include calibration currently in use
- Table 1 and Table 4: updated to include additional analytes and IDAs
- Appendix A: updated terms and definitions from body of SOP
- Appendix B: updated to include additional analytes and IDAs

Revision 4.0

- Updated cover page dates, copyright information, and signatories
- Headers: removed TestAmerica logo and added Eurofins logo
- Throughout: removed references to drinking water. Will add back if adopted.
- Throughout: revised formatting to be consistent
- Section 1.1: added note about addition of Appendix D, removed NJDEP as PAB
- Section 10.1.3: added note about the use of glass pipettes

- Section 10.3: In a previous version of this SOP, Table “Recommended Instrument Operating Conditions” incorrectly referenced PFTrDA as Isotope Dilution, so this was corrected to Internal Standard and added note to contact clients for ISTD quantitation.
- Removed verbiage regarding soil LOQ from Note on Table 1.
- Added Appendix D: NJDEP secondary certified analytes list

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)	Soil/ Sediment (ug/Kg)	Tissue (ug/Kg)
Perfluoroalkylcarboxylic acids (PFCAs)					
Perfluoro-n-butanoic acid	PFBA	375-22-4	2.0	0.20	1.0
Perfluoro-n-pentanoic acid	PFPeA	2706-90-3	2.0	0.20	1.0
Perfluoro-n-hexanoic acid	PFHxA	307-24-4	2.0	0.20	1.0
Perfluoro-n-heptanoic acid	PFHpA	375-85-9	2.0	0.20	1.0
Perfluoro-n-octanoic acid	PFOA	335-67-1	2.0	0.20	1.0
Perfluoro-n-nonanoic acid	PFNA	375-95-1	2.0	0.20	1.0
Perfluoro-n-decanoic acid	PFDA	335-76-2	2.0	0.20	1.0
Perfluoro-n-undecanoic acid	PFUdA	2058-94-8	2.0	0.20	1.0
Perfluoro-n-dodecanoic acid	PFDoA	307-55-1	2.0	0.20	1.0
Perfluoro-n-tridecanoic acid	PFTrDA	72629-94-8	2.0	0.20	1.0
Perfluoro-n-tetradecanoic acid	PFTeDA	376-06-7	2.0	0.20	1.0
Perfluoro-n-hexadecanoic acid	PFHxDA	67905-19-5	2.0	0.20	1.0
Perfluoro-n-octadecanoic acid	PFODA	16517-11-6	2.0	0.20	1.0
Perfluorinated sulfonic acids (PFSAs)					
Perfluoro-1-butanesulfonic acid	PFBS	375-73-5	2.0	0.20	1.0
Perfluoro-1-pentanesulfonic acid	PFPeS	2706-91-4	2.0	0.20	1.0
Perfluoro-1-hexanesulfonic acid	PFHxS	355-46-4	2.0	0.20	1.0
Perfluoro-1-heptanesulfonic acid	PFHpS	375-92-8	2.0	0.20	1.0
Perfluoro-1-octanesulfonic acid	PFOS	1763-23-1	2.0	0.20	1.0
Perfluoro-1-nonanesulfonic acid	PFNS	68259-12-1	2.0	0.20	1.0
Perfluoro-1-decanesulfonic acid	PFDS	335-77-3	2.0	0.20	1.0
Perfluoro-1-dodecanesulfonic acid	PFDoS	79780-39-5	2.0	0.20	1.0
Perfluorinated sulfonamides (FOSA)					
Perfluoro-1-octanesulfonamide	FOSA	754-91-6	2.0	0.20	1.0
Perfluorinated sulfonamidoacetic acids (FOSAA)					
N-ethylperfluoro-1-octanesulfonamidoacetic acid	EtFOSAA	2991-50-6	20.0	2.0	10.0
N-methylperfluoro-1-octanesulfonamidoacetic acid	MeFOSAA	2355-31-9	20.0	2.0	10.0
Fluorotelomer sulfonates (FTS)					
1H,1H,2H,2H-perfluorohexane sulfonate *(4:2)*	4:2 FTS	757124-72-4	20.0	2.0	10.0
1H,1H,2H,2H-perfluorooctane sulfonate *(6:2)*	6:2 FTS	27619-97-2	20.0	2.0	10.0
1H,1H,2H,2H-perfluorodecane sulfonate *(8:2)*	8:2 FTS	39108-34-4	20.0	2.0	10.0
1H,1H,2H,2H-perfluorododecane sulfonate*(10:2)*	10:2 FTS	120226-60-0	20.0	2.0	10.0
Fluorinated Replacement Chemicals					
Hexafluoropropylene oxide dimer acid	HFPO-DA	13252-13-6	4.0	0.40	2.0
4,8-dioxa-3H-perfluorononanoic acid	DONA	919005-14-4	2.0	0.20	1.0
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	F53B Major (9Cl-PF3ONS)	756426-58-1	2.0	0.20	1.0
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	F53B Minor (11Cl-PF3OUdS)	763051-58-1	2.0	0.20	1.0

NOTE: The LOQ values may vary. The Water LOQ is based on a 250mL nominal sample volume.

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
6-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 ≤ 20% (compounds calibrated via IDA) CF = RSD ≤ 25% (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	Non-DW matrices: Standards: 50-150% recovery Field samples: 50-150% recovery (poor responding IDAs: 25-150%) (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: 50-150% of ICAL mean response Post-CCV Samples: Area must be within 50-150% of most recent CCVIS (daily opening 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	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.	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	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	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
Perfluorododecanesulfonic acid (PFDoS)	50-150	70-130	20
Perfluorotridecanoic acid (PFTrDA)	50-150	70-130	20
Perfluorotetradecanoic acid (PFTeDA)	50-150	70-130	20
Perfluorohexadecanoic acid (PFHxDA)	50-150	70-130	20
Perfluorooctadecanoic acid (PFODA)	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
1H,1H,2H,2H Perfluorododecanesulfonate (10:2FTS)	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
Hexafluoropropylene oxide dimer acid	50-150	70-130	20
4,8-dioxa-3H-perfluorononanoic acid	50-150	70-130	20
9-chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	50-150	70-130	20
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	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 sulfonic acids
FOSA: Perfluorinated sulfonamide
PFOA: Perfluorooctanoic acid
PFOS: Perfluorooctane sulfonate
PTFE: Polytetrafluoroethylene (e.g., Teflon®)
SPE: Solid phase extraction**.**
PP: Polypropylene
PE: Polyethylene
HDPE: High density polyethylene
AFFF: Aqueous Film Forming Foam
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
PFDoS	Wellington Laboratories Code: L-PFDoS	Perfluorododecanesulfonic acid	48.4	200		968
PFTrDA	Wellington Laboratories Code: PFTrDA	Perfluorotridecanoic acid	50	200		1000
PFTeDA	Wellington Laboratories Code: PFTeDA	Perfluorotetradecanoic acid	50	200		1000
PFHxDA	Wellington Laboratories Code: PFHxDA	Perfluorohexadecanoic acid	50	200		1000
PFODA	Wellington Laboratories Code: PFODA	Perfluorooctadecanoic 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
10:2FTS	Wellington Laboratories Code: 10:2FTS	1H,1H,2H,2H-perfluorododecane sulfonate (10:2)	48.2	200		964
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
HFPO-DA	Wellington Laboratories Code: HFPO-DA	Hexafluoropropylene oxide dimer acid	50	200		1000
DONA	Wellington Laboratories Code: NaDONA	4,8-dioxa-3H-perfluorononanoic acid	47.1	200		942
9Cl-PF3ONS	Wellington Laboratories Code: 9Cl-PF3ONS	9-Chlorohexadecafluoro-3-oxanone-1-sulfonate	46.6	200		932
11Cl-PF3OUdS	Wellington Laboratories Code: 11Cl-PF3OUdS	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonate	47.1	200		942

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
13C2 PFHxDA	Wellington Laboratories Code: MPFHxDA	$^{13}C_2$-Perfluorohexadecanoic acid	50.0	200		1000
M2-4:2FTS	Wellington Laboratories Code: M2-4:2FTS	Sodium 1H,1H,2H,2H-perfluoro-1-[1,2-$^{13}C_2$]-hexane sulfonate (4:2)	46.7	200		934
M2-6:2FTS	Wellington Laboratories Code: M2-6:2FTS	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: M2-8:2FTS	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

M3HFPO-DA	Wellington Laboratories Code: M3HFPO-DA	$^{13}C_3$-Hexafluoropropylene oxide dimer acid	50.0	200		1000

Solvent: Methanol

PFAS Internal Standard Stock 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 Internal Standard Spiking Solution 2500 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	200	4	2500

Solvent: Methanol

PFAS-IDA-IS Calibration Standards Level 1-Level 6

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 5ppm PFAS-IS Stock 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	72	20.0	180	50	36	50	63	3285	3.6
5	160	50.0	160	50	32	50	80	2800	3.2
6	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

$$ResponseFactor = \frac{Peak\ Area}{Concentration\ of\ Solution (ng/mL)}$$

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

$$\%\,\text{Re}\,covery = \frac{A_t Q_{is}}{A_{is} Q_t RRF_{IDA}} X100$$

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 ($\overline{CF}$) =

$$\overline{CF} = \frac{\sum_{i=1}^{n} CF_i}{n}$$

where: n = number of calibration levels

Standard Deviation of the Calibration Factor (SD) =

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\left(CF_i - \overline{CF}\right)^2}{n-1}}$$

where: n = number of calibration levels

Percent Relative Standard Deviation (RSD) of the Calibration Factor =

$$\frac{SD}{\overline{CF}} \times 100\%$$

Percent Difference (%D) =

$$\frac{CF_v - \overline{CF}}{\overline{CF}} \times 100\%$$

where: CF_v = Calibration Factor from the Continuing Calibration Verification (CCV)

Percent Drift =

$$\frac{\text{Calculated Concentration} - \text{Theoretical Concentration}}{\text{Theoretical Concentration}} \times 100\%$$

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.

Appendix D: Analytes applied for Secondary Certification with NJDEP

Compound Name	Abbreviation	CAS #
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	PFUdA (PFUnA)	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA (PFTA)	376-06-7
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorooctanesulfonic acid	PFOS	1763-23-1

APPENDIX E

Resumes of Key Project Personnel

DONALD C. ANNÉ
SENIOR CHEMIST

EDUCATION:	M.S., Chemical Oceanography, Florida Institute of Technology, 1981 B.A., Earth Sciences, Millersville University of Pennsylvania, 1975
SPECIAL TRAINING:	Certified 40-Hour OSHA Health and Safety Certified 8-Hour OSHA Supervisory Course Ground Water Geochemistry (NWWA) Ground Water Pollution and Hydrology (Princeton Associates) Quality Assurance Programs for Environmental Monitoring Data (Stat-A-Matrix)
PROFESSIONAL AFFILIATIONS:	American Chemical Society (AFS), 1979-Present

EXPERIENCE SUMMARY:

Mr. Anné has more than 39 years of environmental chemistry experience specializing in data validation, environmental sampling, analytical methodologies, petroleum fingerprinting, laboratory audits, field sampling audits, and preparing Quality Assurance Project Plans and Quality Assurance Manuals. Mr. Anné's experience includes analytical laboratory work with gas chromatography, atomic absorption, infrared spectrometry and wet chemistry methods.

PROJECT EXPERIENCE:

Quality Assurance/Quality Control of Chemical Data- Data Validation

Mr. Anné has more than 23 years experience as a data validator and quality assurance officer. Mr. Anné has validated data for most EPA Regions and under several independent state programs, including the NYSDEC. He has performed laboratory and field audits as well as written Quality Assurance Project Plans. Mr. Anné has written, reviewed, and initiated laboratory Quality Assurance Manuals for laboratories to maintain their regulatory compliance. Typical project experience includes:

- Senior Chemist responsible for data validation. Reviewed chemical data for numerous projects under the New Jersey ISRA regulations. Data validation typically is performed as a third-party validator under subcontract to consultants for private industry and utility companies.

- Supervising Environmental Scientist responsible for data validation. Reviewed chemical laboratory data for adherence to QA/QC protocols for several key projects, including National Priorities List sites and RCRA Corrective Actions located in EPA Regions I, II, III, IV, V, and IX. Validated analytical data, outlined problems and actions to be taken, and qualified all affected data. Consulted with project managers on data usability, and recommended corrective actions to support project goals. Responded to comments made by regulators regarding data quality.

- Supervising Environmental Scientist recognized by the New York State Department of Environmental Conservation (NYSDEC) to perform third party data validation. Attended NYSDEC workshop on data validation as part of the requirements set forth by NYSDEC. Performed data validation in support of NYSDEC ASP programs as well as data in support of the NYSDEC Part 360 Regulations for landfills. Validated data for an Albany area municipal landfill.

- Supervising Environmental Scientist responsible for developing and preparing Quality Assurance Project Plans (QAPPs) for several state and federal Superfund sites and federal RCRA corrective action sites. Negotiated with regulators for the acceptance of the QAPPs. The sites were located throughout the eastern United States.

- Environmental Chemist responsible for developing a laboratory QA/QC program which fulfilled requirements of the EPA and agencies from the States of Texas and Louisiana. Implemented and managed the program throughout DOE's SPR Environmental laboratories. Received verbal commendations from EPA and the Texas Water commission on the QA/QC Program.

Related Chemistry Experience:

Mr. Anné is experienced in sampling soil, water, air, and wastes in accordance with federal and state guidelines. He has performed field sampling audits and prepared sampling plans for numerous projects in accordance with applicable programmatic requirements. Mr. Anné is familiar with the geochemical aspects of fate and transport of contaminants.

Mr. Anné also has experience working in both fixed-base and mobile laboratories. His experience includes the use of gas chromatography, atomic absorption spectrometers, infrared spectrometers, and numerous wet chemistry and preparation equipment methods. He has served in the laboratory as an analyst, laboratory advisor, and QA officer. He has interfaced with regulators in the area of analytical chemistry and has experience in petroleum fingerprinting techniques and methods.

EMPLOYMENT:

2005- present, Alpha Geoscience
1998-2005, Alpha Environmental Consultants, Inc.
1990-1998, McLaren/Hart
1986-1990, Fred C. Hart Associates
1985-1986, Boeing Petroleum Services
1982-1985, Petroleum Operations and Support Services
1981-1982, Dravo Utility Constructors
1979-1981, Florida Institute of Technology
1975-1979, Berkley Products Company

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PROJECT MANAGER

MARK E. WRIGHT, PG, CSP, CHMM

ROLE AND RESPONSIBILITY

As a Project Manager for this contract, Mr. Wright will be responsible for the administration of work required by the Work Assignment. The management of each work assignment may include development of work scope and cost assessments, procurement of supporting subcontractors and/or consultants, coordination of work scope items from resource management to scheduling and implementation. Mr. Wright will work with the Quality Assurance Officer to develop site-specific quality assurance plans, as pertinent to the Work Assignment and will act as the primary point of contact for each assigned project.

IDENTIFIED WORK ELEMENTS EXPERIENCE

- Site Characterization
- Phased Remedial Investigation/Feasibility Study (RI/FS)
- Soil Vapor Intrusion (SVI) Investigations
- Site Response Activities/Interim Remedial Measures (IRM)
- Site Management (SM)
- Analytical Quality Assurance/Quality Control Activities (QA/QC)
- Citizen Participation (CP) Activities
- Health and Safety Plan (HASP) Development
- Potentially Responsible Parties (PRP) and Third-Party Oversight

SUMMARY OF QUALIFICATIONS

Mr. Wright has over 13 years of experience in conducting environmental investigations. Mr. Wright is experienced in all phases of environmental investigation projects, including Completing the initial Site Characterization Investigation, Completing Remedial Investigations and Feasibility studies, Soil Vapor Intrusion Studies, the selection and implementation of Interim Remedial Measures, the development and implementation of Quality Assurance Project Plans, the development and implementation of site specific Health and Safety Plans, participation in Citizen participation activities, implementation of Site Management Plans, and Third Party Oversight.

Mr. Wright has completed a diverse array of site investigations including investigations into groundwater contamination in various media including, overburden, fractured bedrock, and competent bed rock as well as the interaction between different aquifers. Mr. Wright has used investigation data to develop conceptual site models, including groundwater flow and contaminant transport, the completion of Aquifer testing to establish aquifer characteristics, the implementation of geophysical techniques and the uploading of data to EQuIS. In addition to completing investigatory step during projects Mr. Wright develops and tracks project budgets and other project management elements. Mr. Wright has provided these services on a number of projects for governmental, municipal, commercial and industrial clients.

Mr. Wright's areas of expertise include Site Characterizations and Remedial Investigations. Mr. Wright specializes in the investigation of contaminated groundwater plumes, including source area investigations, plume degree and extent and the identification of potential receptors of contaminated groundwater.

NSPE LEVEL

VI

EDUCATION

- BS, Water Resources, State University of New York Collage at Oneonta, 2003

PROFESSIONAL REGISTRATIONS/ CERTIFICATIONS

- PG, #693, NY
- Certified Safety Professional (#31227)
- Certified Hazardous Materials Manager (#173260)

PROFESSIONAL ORGANIZATIONS

- Environmental Professionals Organization of Connecticut
- National Ground Water Association

TRAINING

- OSHA 40 Hour Health and Safety for Hazardous Waste Site
- OSHA 8 Hour Supervisor of Hazardous Waste Operation

BASE OFFICE LOCATION

Clifton Park, NY

EXPERIENCE

MANAGEMENT OF INACTIVE HAZARDOUS WASTE, HAZARDOUS SUBSTANCE AND PETROLEUM SPILL SITES

Site Management of Petroleum Spill and Hazardous Waste Site, NYSDEC Contract D006130, North Lawrence Oil Dump Site, North Lawrence, NY

Served as a Senior Project Geologist for the NYSDEC North Lawrence Oil Dump Site. Responsibilities included implementation of the Site Management Plan, including monitored natural attenuation groundwater sampling, landfill gas monitoring and site inspections; the development of sampling reduction plans to eliminate several wells from the sampling program, oversight groundwater monitoring well decommissioning for a portion of the groundwater monitoring network. Analysis of groundwater sampling results and preparation of Periodic Review Reports. Services were completed in 2015.

Site Characterization of Petroleum Spill and Hazardous Waste Site, NYSOGS Contract SA 953, Fishkill Correctional Facility, Beacon, NY

Mr. Wright served as a Project Manager for this NYSOGS project to conduct an environmental sampling program during the development of the bid documents for the replacement of three 100,000 gallon AST at the boiler house of the correctional facility. Responsibilities included working with NYSOGS Project Managers on the development of a Site Characterization Plan, coordination with DOCs personnel to clear security requirements, oversight of the use of ground penetrating radar prior to initiating a soil boring program, field oversight of the installation of soil borings to identify areas of environmental impact from the historic use of the area as a tank farm, and the use of lead based paint on the system pipiing, identifying areas of lead paint using XRF equipment and collecting samples of building materials for the presence of PCBs. Information collected during the site characterization was used define the volumes of soil to be removed during the replacement of three 100,000 gallon AST at the boiler house of the correctional facility.

Site Characterization of Petroleum Spill and Hazardous Waste Site, NYSOGS, Contract SA 953, Otisville Correctional Facility, Building 165, Otisville, NY

Mr. Wright served as a Project Manager for this NYSOGS project to conduct a Site Characterization, in accordance with DER-10, during removal of a 1,000 gallon UST at building 165 of the correctional facility. Responsibilities included budget and scope development, field oversight of UST contractors conducting the removal, screening environmental media uncovered during the removal to identify a release of product to the environment, spill reporting, coordination with OGS field Engineer to approve and execute an immediate environmental remedial excavation, collection of environmental samples in coordination with OGS field Engineers and NYSDEC Spill Engineers, with NYSDEC requirements, completion of UST closure report, including request to close the spill, follow-up with NYSDEC to ensure spill was closed meeting standards.

Site Characterization of Petroleum Spill and Hazardous Waste Site, NYSOGS, Contract SA 953, DOT Region 9 Maintenance Sub-Headquarters, Schenevus, NY

Mr. Wright served as a Project Manager for this NYSOGS project to conduct a Site Characterization, in accordance with DER-10 during removal of a 1,000 and a 4,000 gallon UST at the DOT facility. Responsibilities, budget and scope development, field oversight of UST contractors conducting the removal, screening environmental media uncovered during the removal to identify a release of product to the environment, spill reporting, coordination with OGS field Engineer to approve and execute an immediate environmental remedial excavation, coordination with UST contractors to segregate and stockpile impacted soils, Coordination with OGS project Engineer and DEC spill manager to secure approval for onsite treatment and reuse of contaminated soil, collection of environmental samples in accordance with NYSDEC requirements, completion of UST closure report, including request to close the spill, follow-up with NYSDEC to ensure spill was closed meeting standards.

Aquifer Testing in support of Groundwater Withdrawal Permit, Kraft Foods, Campbell, NY

Served as Project Manager for the completion of an aquifer testing program in support of a Groundwater Withdrawal Permit approval from the Susquehanna River Basin Commission, Responsibilities included development of Aquifer Test Plan, obtaining general permit from the ACOE for weir construction, planning and oversight of installation of monitoring well network, public notifications for testing, coordination with neighboring property owners to conduct monitoring on their property, data collection, data analysis, including the calculating of aquifer flow parameters and long term stability of the proposed water withdrawal as well as permit form completion and submittal.

Emerging Contaminants Sampling, Balchem Corporation, Slate Hill, NY

Served as a Project Manager for the development and implementation of a emerging contaminates sampling program at a Class 04 State Superfund Program Site. Responsibilities included reviewing historic data to create a sampling plan for PFAS and 1,4-dioxane in the two groundwater aquifers on-site, submittal of the plan to the NYSDEC project manager for approval,

EXPERIENCE

development of a field sampling plan and training program to ensure that cross contamination was avoided during sampling, oversight of the sampling program and data analysis and reporting. Services were completed in 2018.

Site Management, Phased Remedial Investigation/Feasibility Study of Petroleum Spill and Hazardous Waste Site, Brownfields Site, Ulster County, NY
Served as a Project Manager for the completion of a Remedial Investigation/Feasibility Study and site management of a brownfield clean-up program of an inactive waste disposal site in Ulster County, NY. Project responsibilities included working under the supervision of the NYSDEC Project Manager to review historical data and using that data to aide in the development of a Remedial Investigation strategy, development of a field activities plan, development of a site specific health and safety plan, and coordination with the NYSDOH, NYSDEC and site owners to identify and investigate all potential receptors of subsurface contamination in the area that could impact human health and the environment. Specialized tasks performed during the investigation include: Interpretation of Ground Penetrating Radar (GPR) Electromagnetic Survey(EM) data to identify the location of subsurface anomalies indicative of disposal areas, Completion of soil vapor intrusion evaluation, including the evaluation of sampling network based on interpretation of geologic data, the use of passive gas sample network, and evaluation of passive soil gas data to identify potential groundwater contamination source areas, oversight of test pit installation in order to horizontally delineate subsurface contamination. oversight of soil boring installation to delineate contamination horizontally and vertically, the installation and sampling of a monitoring well network, the development of remedial alternatives, and the development and implementation of ad Site management Plan for the selected remedial strategy of monitored natural attenuation.

Site Characterization of Petroleum Spill and Hazardous Waste Site, NYSDEC Contract D006130 Site Characterization McCall Place, Newburgh, NY
Served as a Senior Project Geologist for the Site Characterization completed at the NYSDEC McCall Place Site. The Site Characterization was completed to identify the source of chlorinated solvents detected in private drinking water wells located along McCall Place. Proect responsibilities included working with NYSDEC Project Manager to review historical data and using that data to aide in the development of a Site Characterization strategy, development of a field activities plan, development of a site specific health and safety plan, and coordination with the NYSDOH, NYSDEC and area residents to identify and investigate all potential receptors of subsurface contamination in the area that could impact human health and the environment. Specialized tasks performed during the investigation include: The use of passive soil gas sampling and ground penetrating radar to identify potential hazardous waste disposal areas; the planning and oversight of the installation of an area wide groundwater monitoring well network, interpretation of groundwater flow and contaminant concentration data development and maintenance of conceptual site model, and the upload of project data to the NYSDEC EQuIS sever. The results of the site characterization identify three distinct plumes of chlorinated solvents in the area of the site, however a specific source area could not be identified.

Phased Remedial Investigation/Feasibility Study, Site Response Activities/Interim Remedial Measures of Petroleum Spill and Hazardous Waste Site, NYSDEC Contract D006130, Barthelmes Manufacturing Site, Rochester, NY
Served as a Senior Project Geologist for the Remedial Investigation/Feasibility Study, including Interim Remedial Measures, completed at the NYSDEC Barthelmes Manufacturing Site. The Remedial Investigation/Feasibility Study was completed to define the degree and extent of subsurface contamination related to the historic use of the site as a manufacturing facility. Project responsibilities included working with NYSDEC Project Manager to review historical data and using that data to aide in the development of a Remedial Investigation strategy, development of a field activities plan, development of a site specific health and safety plan, and coordination with the NYSDOH, NYSDEC and site owners to identify and investigate all potential receptors of subsurface contamination in the area that could impact human health and the environment. Specialized tasks performed during the investigation include: the completion of an Interim Remedial Measure to remove source material contributing to a chlorinated solvent groundwater plume. The IRM consisted of the removal of soil from under the slab on grade foundation of the building. Other task included the evaluation of an existing groundwater monitoring well network, planning and oversight of the installation additional groundwater monitoring wells to supplement the existing monitoring well network, interpretation of groundwater flow and contaminant concentration data, development and maintenance of conceptual site model to identify the source and potential receptors of subsurface contamination including evaluating hydrogeologic conditions for use in the evaluation of potential remedial actions, and the upload of project data to the NYSDEC EQuIS sever.

SENIOR PROJECT GEOLOGIST (STAFF)

MICHAEL A. VARNI, LEP

IDENTIFIED WORK ELEMENTS EXPERIENCE

- Site Characterization
- Phased Remedial Investigation/Feasibility Study (RI/FS)
- Soil Vapor Intrusion (SVI) Investigations
- Analytical Quality Assurance/Quality Control Activities (QA/QC)
- Citizen Participation (CP) Activities
- Health and Safety Plan (HASP) Development
- Potentially Responsible Parties (PRP) and Third-Party Oversight

SUMMARY OF QUALIFICATIONS

Mr. Varni has over 10 years of experience in environmental assessment and site investigation. He has performed these services for a number of governmental, municipal, commercial, industrial and private clients. Specifically, Mr. Varni has been responsible for Phase I Environmental Site Assessments at small- to large-scale commercial and industrial facilities. In all cases, the specific manufacturing processes were analyzed and waste streams were defined to identify all potential sources and releases of contaminants to the environment. Mr. Varni has performed numerous Phase II and Phase III investigations involving drilling and test pit supervision, monitoring well installation, and sampling of soils, groundwater, and soil vapor. Mr. Varni has performed numerous site remediation oversight projects including soil excavation, groundwater treatment systems, and vapor extraction systems.

Remedial Actions, West Hartford, CT

This project involved the cleanup and redevelopment of a former large engine break and drill chuck manufacturer contaminated with PCBs, petroleum, and chlorinated solvents. The project involved demolition of the existing industrial building, followed by removal of subslab piping and drainage structures, and finally remediation of soils to achieve compliance with both state and federal regulations. Mr. Varni's responsibilities included supervision of remediation contractors conducting soil excavation, field monitoring and sampling of soil and groundwater, field monitoring of dust and weather conditions according to a project specific remediation and health and safety plan, coordination with construction and remediation crews, and data management and analysis. The project culminated in a successful Brownfields-type redevelopment of the property into a retail shopping center.

Phase I Environmental Site Assessments

- Inspection of a wide variety of commercial and industrial facilities and properties to identify specific site environmental conditions and concerns
- Interviewing site contacts and municipal, state, and federal officials to determine current and former site use and environmental concerns
- Historical research into current and former land use and regulatory history through review of aerial photographs and other published sources and state and local agency records
- Review of published geologic data to determine site setting including surficial and bedrock geology, and groundwater and surface water, and other environmental factors to evaluation contaminant migration potential.

Phase II and III Subsurface Investigations

- Identification of potential contamination sources at sites due to present and historical land uses
- Collection, description, and interpretation of split spoon sediment samples

NSPE LEVEL

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EDUCATION

- MS, Geology, University of Maryland, College Park, Maryland, 2002
- BS, Environmental Earth Science, Eastern Connecticut State University, Willimantic, Connecticut, 1999

TRAINING

- OSHA 40 Hour Hazardous Waste Operations & Emergency Response
- OSHA 8 Hour Refresher Hazardous Waste Operations & Emergency Response

PUBLICATIONS

- The effect of rising atmospheric oxygen on carbon and sulfur isotope anomalies in Neoproterozoic Johnnie Formation, Death Valley, USA. Kaufman, A. J., Corsetti, F.A., and Varni, M.A.

BASE OFFICE LOCATION

Farmington, CT